MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 35 APRIL, 1929 Number 8

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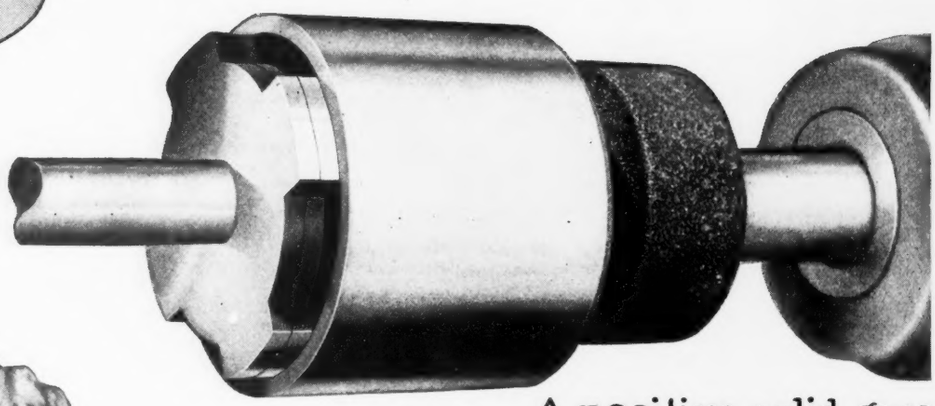

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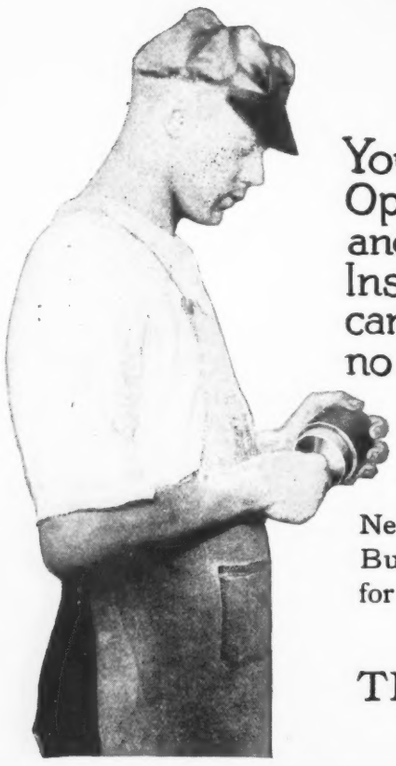

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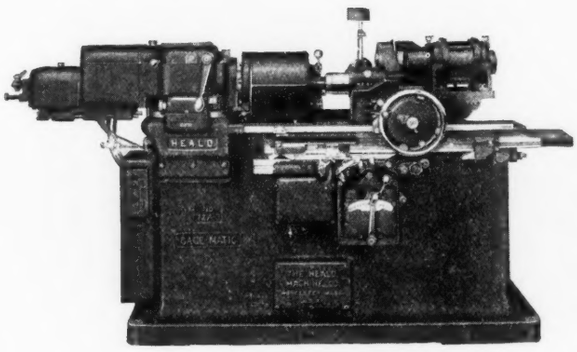

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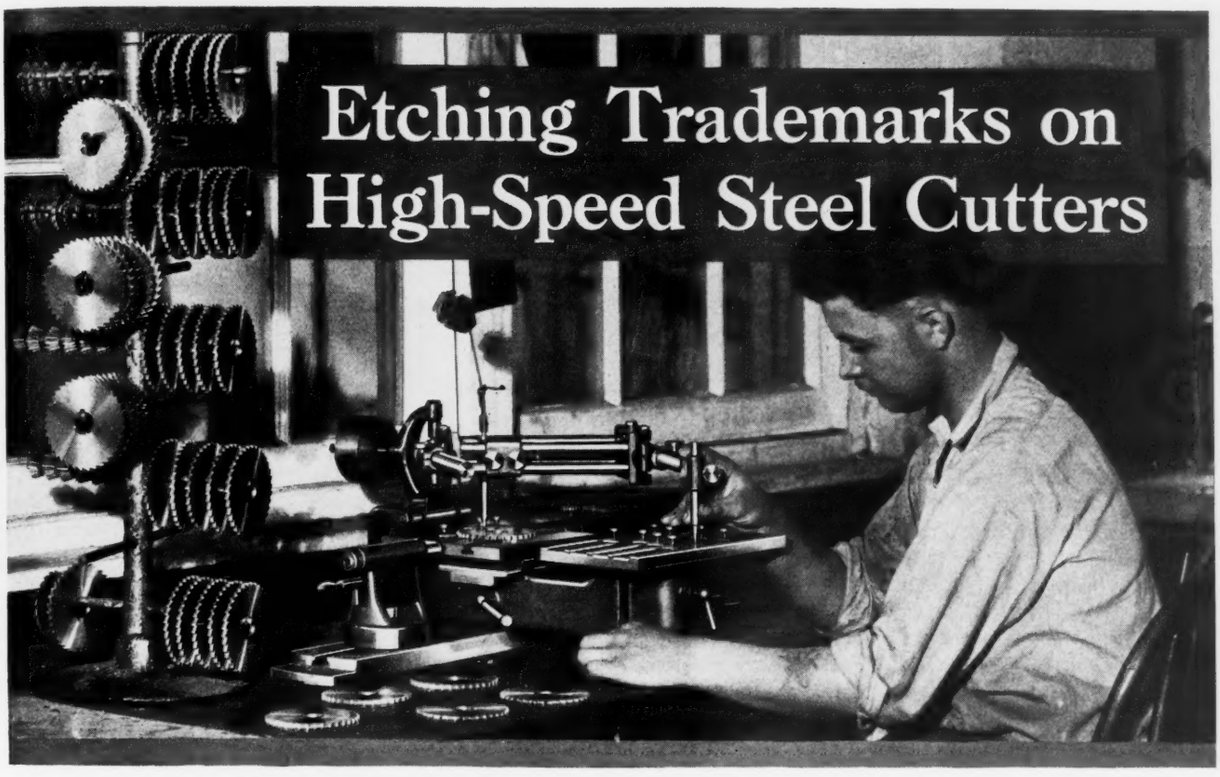


Etching Trademarks on High-Speed Steel Cutters

How the Standard Tool Co. Etches Trademarks and Sizes on Thin Slitting Saws, Small Angular Cutters and Similar Tools

By CHARLES O. HERB

ETCHING with acid has long been known as a method of marking steel, but its application is not always successful due to inadequate knowledge concerning the process. When the etching is done properly, the trademarks, numbers, letters, etc., are clean and sharp. One special advantage of the process is that hardened steel can be easily marked. Etching can also be done on surfaces that must fit mating parts accurately, without destroying the fit. Another advantage of etching is that thin parts can be marked without stressing them. Angular milling cutters and other parts that are difficult to mark by other methods can usually be etched conveniently.

It is the practice of the Standard Tool Co., Cleveland, Ohio, to employ the etching process for marking all slitting cutters, small angular milling cutters, straight round reamers, expansion reamers, and all tools that require a hardened and round-ground surface over the entire piece. The process has been thoroughly investigated by the chemical laboratory of this company, and as followed out in the shop, proves altogether satisfactory. Parts that can be marked by stamping or rolling under steel dies without straining them or destroying fits are marked by either of those methods rather than by etching, since the former methods permit higher production rates and are proportionately less expensive, due primarily to the decreased labor charge per piece.

Cutters to be Etched are First Immersed in Melted Wax

Successful etching of steel parts depends upon the proper application of the ground used to protect the major portion of the parts from the action of the acid. Wax is generally used for this purpose. At the plant of the Standard Tool Co., the parts are coated with wax made up of three parts of paraffin to one part of beeswax, on the basis of weight. Paraffin made by the Standard Oil Co. and commercial beeswax of good quality are used.

The coating is usually applied all over the parts by immersing them in a bath of melted wax, which is maintained at a temperature of about 165 degrees F. This bath is contained in the rectangular iron pot shown in Fig. 1, on the bottom of which rests a steam coil for furnishing the desired temperature. The cutters are hung on the arms of a spider which is mounted over the tank and is slowly turned by means of the crank-handle to carry the cutters once into and out of the molten wax.

The turning of the crank-handle should be slow enough to permit the cutters to reach the approximate temperature of the bath as they pass through it. When the cutters come from the bath, they are permitted to drain momentarily, and are then hung on the stand seen at the right of the tank, until the wax reaches the proper degree of hardness for scribing. It will be seen that there is a hinged bar on the left-hand side of the tank, which may be engaged with one of four slots in a disk mounted on the corresponding end of the spider shaft to lock this shaft in four different positions.

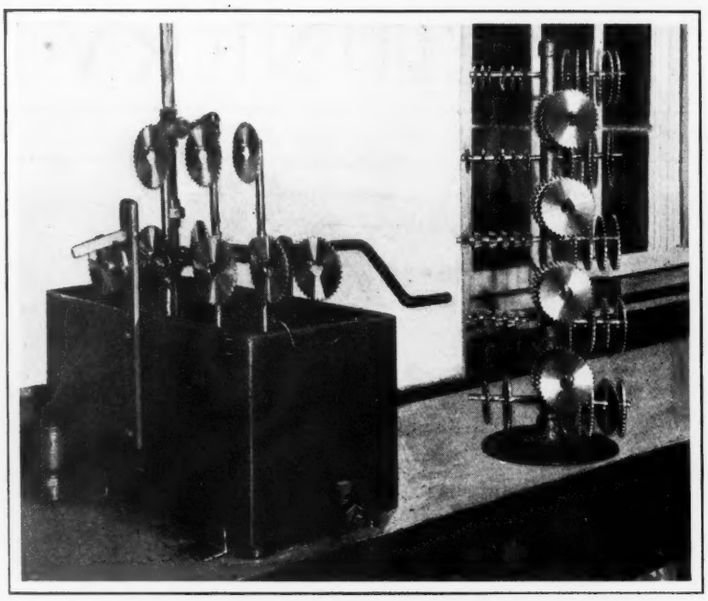


Fig. 1. Tank of Molten Wax through which the Cutters are Slowly Passed

Before applying the wax on the cutters, it is important that the parts be thoroughly cleansed of all dirt, oil, or water. Otherwise, the wax will not adhere firmly to the steel surfaces, with the result that when the acid is later applied, it will spread beneath the wax and eat unsightly blotches into the steel. The temperature of the bath and of the parts also controls to a considerable degree the adherent properties of the wax.

The consistency of the melted wax and the rate of speed at which the cutters are passed through it control the thickness of the coating. The coating should be sufficiently thick to guard against acid fumes passing through it and discoloring the steel. On the other hand, it must not be too thick or else it will be readily broken when scribed and will permit the acid to run along the fractures in the wax. The wax coating varies from 1/64 to 1/32 inch in thickness. Reamers and similar tools are waxed locally by dipping them into the wax by hand.

Scribing by Machine Gives Artistic Results

Artistic trademarks, numbers, and letters are produced with uniformity on the cutters by using the pantograph machine illustrated in Fig. 3, which controls the movements of a scriber over the waxed surface of the cutters. The scriber, which is contained in holder *A*, is a non-rotating hardened steel piece that is ground to a conical point. The holder slides in a vertical sleeve, the upper end being connected to a foot-treadle through a cord which runs on an overhead pulley. By operating the foot-treadle, the scriber can thus be easily raised from the surface of the cutter in finishing numbers or designs. In starting the next number, the scriber is dropped on the cutter with a snap, through the action of a counterweight fastened to the cord, which insures complete penetration of the wax by the scriber.

Through the pantograph mechanism, various amounts of reduction can be obtained between the templets and the work, the usual reduction being 7 to 1. The templets are clamped in slots in table *B*, and as the operator moves guide pin *C* of the pantograph mechanism in the templet grooves, scriber *A* makes similar movements on a reduced scale on the work, cutting through the wax sufficiently to permit the acid to attack the steel as desired. From two to four lines of information are usually scribed on the cutters. The pantograph mechanism is hinged at *D* so that the guide pin and scriber can be easily raised or lowered for changing the work. A counterweight raises this as soon as the operator releases pressure on it.

For the scribing operation, flat cutters are merely laid on the work-table as shown, being properly located beneath the scriber by pushing them against two stop-blocks arranged to form a vee. Sometimes, when considerable data is to be engraved, the cutters are revolved by hand beneath the scriber as the guide pin is moved over the templets. By merely adjusting the pantograph arms, long narrow letters, square letters, slanting letters, or other forms can be scribed from the same templets. When cylindrical work is to be marked, the work-table is removed and the parts are held between the centers of tailstocks *E* and *F*. This machine is built by Friedrich Deckel, München, Germany.

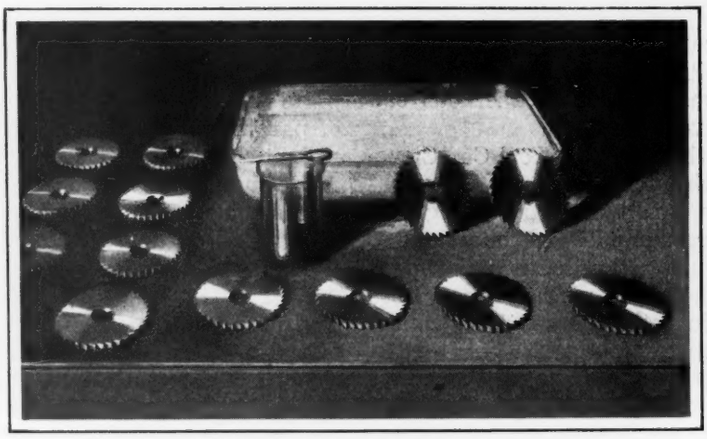


Fig. 2. Cutters Spread out on Table Ready for the Etching Acid

Before the scribing is done, the waxed cutters are permitted to hang on the stand seen at the right in Fig. 1 for a few minutes until the wax has solidified to the

proper degree of hardness. If the wax is too soft, the point of the scriber will have a tendency to make a very heavy line and, at times, will lift wax from the tool being etched. On the other hand, if the wax is mixed in the proper proportions, say 3 to 1, it will never become brittle and crack or break. At times, tools have been left on the rack for three or four days after being waxed and before being scribed.

Applying the Etching Acid

As the cutters are taken from the scribing machine they are laid on the adjacent section of the bench, as illustrated in Fig. 2, ready for applying the etching acid. Small quantities of this acid are drawn from the glass beaker by means of a medicine dropper and forced on the scribed portion of the wax on the cutters to form a small pool. When the acid has been permitted to act until the steel has been eaten away to a depth of about 0.005 inch along the scribed lines, the acid is drained back into the beaker. This requires about one-half minute with the new acid and one minute with old. The cutter is then dipped into a solution of slacked lime and water, seen in the background in Fig. 2. This solution of slacked lime stops the action of the acid. The length of time that the acid is permitted to act depends somewhat upon its freshness.

The acid used for these high-speed steel cutters is made up of equal parts of hydrochloric and nitric acids, chemically pure acids being used. Care must be taken in mixing them, since the heat generated causes the new solution to boil so energetically that it is likely to spatter and damage clothing, tools, etc. It should never be stopped up, as the action of the acid in such a case will burst the bottle if it cannot force out the stopper.

Mixing of the two acids should be done under an exhaust hood or in the open, because the fumes are very pungent. The solution should be allowed to stand until the boiling action ceases entirely and all fumes have been expelled.

Wax Removed by Dipping in "Carbona"

When the cutters are removed from the slacked lime they are placed, several dozen at a time, in a basket made up of steel slats, which is then immersed in a tank about 18 inches in diameter, filled with "Carbona." The basket is shaken to permit the cleaning fluid to reach all surfaces of the cutters and thoroughly clean of the wax. When the cutters are taken from this bath, they dry readily and are transferred to the packing and shipping department. Each bath of "Carbona" is good for cleaning from 500 to 600 cutters.

The process is more rapid than might be assumed on first thought. Each operator can easily etch cutters having about twenty different numbers and letters at the rate of several hundred in a day.

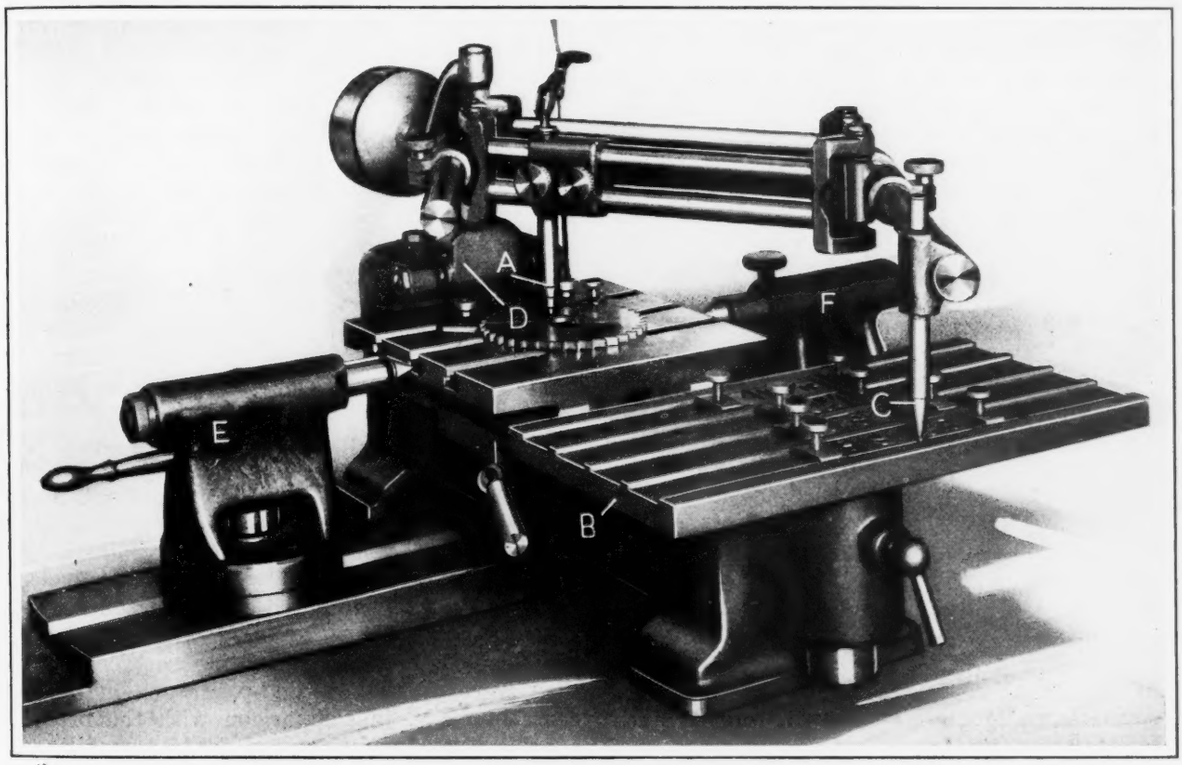


Fig. 3. Pantograph Machine Employed in Scribing Designs, Numbers, and other Inscriptions through the Wax

* * *

FOUNDRYMEN TO MEET IN CHICAGO

The American Foundrymen's Association will hold its 1929 convention and exhibition at the Stevens Hotel, Chicago, Ill., April 8 to 11. A great number of papers will be read and technical sessions will be held pertaining to foundry costs, malleable iron foundry, steel foundry and gray iron foundry practice, cast iron metallurgy, foundry management, sand control, non-ferrous foundry practice, materials handling, foremen training, and apprentice training. Further information may be obtained from C. E. Hoyt, executive secretary-treasurer, 222 W. Adams St., Chicago, Ill.

What Causes Ball Bearing Troubles?

Most Troubles with Ball Bearings are Caused by not Following the Directions for Mounting and Care that are Given by the Bearing Manufacturer

By ASHER GOLDEN, RBF Ball Bearing Co., New York City

THE directions for the mounting and application of ball bearings that are furnished by the bearing manufacturers give the user the necessary information as to what to do and what to avoid in order that bearings may function properly at maximum efficiency and live to a good old age. Many users, however, do not take the time to read these directions, because they believe that they know how to apply and use ball bearings. As a result, if when mounting a bearing, one of the rings cracks, the user is likely to jump at the conclusion that the bearing is defective. If a bearing has been in use but a short time and becomes rough and noisy, no attempt is made to determine the cause, but it is assumed that the bearing is defective and it is returned to the manufacturer. As a matter of fact, if a bearing fails in any way whatever, it is assumed that the bearing is defective, and no thought is given to the possibility that the trouble may be due to the fact that the directions given by the manufacturer were not followed.

This attitude creates a serious problem for the bearing manufacturer whose product is unjustly condemned; it also causes expense and loss to the user of ball bearings who installs them in machines that he subsequently sells, and whose product, therefore, with improperly installed bearings, may be condemned by the ultimate consumer.

A Small Speck of Dirt Often is the Sole Cause of Bearing Troubles

A case came to the writer's attention recently that illustrates this point. A manufacturer of machine tools returned a considerable number of bearings as defective. He claimed that the bearings were of poor quality and that in consequence he had received many complaints from his customers and been put to considerable expense as well as suffering a loss of prestige. The bearings were carefully examined and the failure correctly diagnosed as being due to dirt.

At another time a user complained that in a lot of bearings received the holes were of different sizes. Some were correct, while others were too large or too small. It had never occurred to the person who found difficulty in assembling the bearings that the fault might lie with the spindles to which the bearings were fitted. This was suggested, and nothing further was heard of this complaint.

In another case, a user brought in a bearing that he claimed to be defective. He removed the bearing from a dusty box, held it by the inner ring with one hand and turned the outer ring slowly with the other. "Feel that," he said; it has a high spot." We examined the bearing and found that the "high spot" was just a particle of dirt. The "high spot" was removed by simply washing the bearing with kerosene.

To Give Satisfactory Service, Ball Bearings must be Kept Clean

I believe that bearing manufacturers would have fewer complaints and come nearer to the solution of this vexing problem if they attacked it backward—that is, started with the effect and went back to the cause. The directions might read, for example: "If on removing a bearing that has been in service but a short time it is found that the surface of the inner ring adjacent to the shaft is partly or wholly polished, then the bearing has worked loose on the shaft and the shaft has been turning in the inner ring; dirt may have caused this condition by working its way into the bearing and locking or jamming it. Do not expect a bearing to give satisfactory service unless it is kept clean."

I believe that the effects of abuses of ball bearings in one form or another might be all referred to in a pamphlet, which could be sent to a user who complains of defective bearings, and his attention could be directed to the particular paragraph that treats of the cause of the failure in his case. I believe that this would have a tendency to discourage unwarranted and unreasonable complaints.

When ball bearings came into use for bicycles, they were of the cup-and-cone type and rather coarsely made, in comparison with the precision bearings now manufactured for automobiles and machinery. No special directions were necessary for mounting and using bearings of the cup-and-cone type. Dirt in the bearing or some extra pull on the wrench in adjusting it did not seriously affect its operation. With the advent of the precision bearing, however, it became necessary and important to instruct the user how to fit and mount it and how to take care of it. The fit between the balls and the raceways of such bearings is so close that dirt seriously affects the operation.

Ball Bearings are Subjected to Rigid Tests and Inspection

Owing to the extreme care that leading ball bearing manufacturers take in putting their product through every conceivable test to disclose defects before the bearings are shipped, it is safe to say that not more than one bearing in a thousand that is alleged to be defective has anything the matter mounting or abuse in service.

The bearing manufacturer, however, is responsible for the difficult problem that has arisen in regard to perfect bearings being claimed to be

defective. He is responsible, for the simple reason that he has encouraged the user to complain that the bearing is defective, as soon as something seems to go wrong with it. Ball bearing manufacturers have offered to replace bearings that proved defective, giving the buyer the idea that some bearings that get out into the market are actually defective; hence, what is more natural than to take advantage of the manufacturers' offer to replace the bearing whenever it fails prematurely? Of course, it is possible for a defective bearing to pass even the very rigid inspections and tests of the bearing manufacturer, but the probability is so remote that defective bearings are extremely rare —so rare that no special guarantee is needed to take care of this condition.

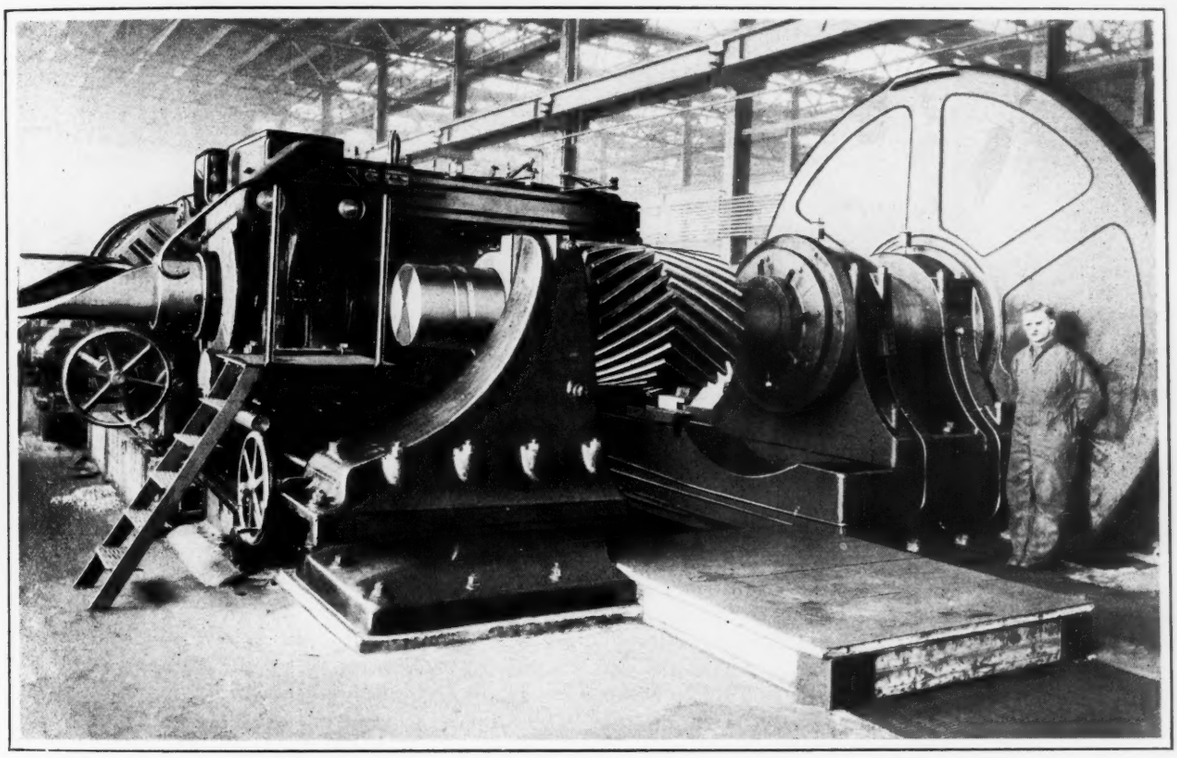
It is not necessary to enumerate here all the tests to which modern ball bearings are subjected. Suffice it to say that there are no known methods of inspecting or testing ball bearings to assure their freedom from defects, that are not being applied. Not only is the completed bearing thoroughly tested, but these inspection tests are also applied between every operation until the bearing is completed. In a following article, the writer will outline the defects most generally claimed to have been found in ball bearings and will point out the causes of the difficulties encountered.

* * *

A great deal of waste is due to the use of oil-cans that leak either around the rim or along the seam in the spout. Much of the oil that one sees around a machine shop is not there for any good purpose, but represents merely an unnecessary waste.

A HUGE GEAR-CUTTING MACHINE

A Sykes gear-cutting machine of unusual proportions has recently been built by the Farrel-Birmingham Co., Inc., Buffalo, N. Y., for generating large double helical and spur gears in the company's own plant. The general principles of the Sykes process of cutting gears, especially as applied to the generating of double helical or herringbone gears of the continuous-tooth type, were described in an article, "Generating Herringbone Gears," in November, 1925, MACHINERY, and machines for cutting gears in the more usual size ranges were described in MACHINERY, February, 1927, page 474, and June, 1928, page 777.



Large Gear Generator of Sykes Type which will Cut Gears 19 Feet in Diameter

The machine recently completed has a capacity far beyond that of the machines previously described. It will cut gears up to 19 feet in diameter with a 54-inch width of face, and has a capacity for cutting teeth of over 4-inch circular pitch in double helical gears, and 6-inch circular pitch in straight-tooth spur gears. Provision is made for cutting gears integral with their shafts up to shaft diameters of 22 inches.

A few of the general dimensions of the machine, which is shown in the accompanying illustration, will indicate its huge proportions. The indexing worm-wheel is 12 feet in diameter, and the cutter index wheel, 3 feet in diameter. Cutters up to 18 inches pitch diameter are employed. The total width of the machine is 20 feet; its length, 25 feet; and its height over the floor line, 12 feet.

Gears of the large sizes and pitches that can be cut on this machine are used in many branches of industry, especially for rolling mills, heavy power presses, coal pulverizing equipment, and heavy hoisting work.

MILLING CONNECTING-ROD BOSSES

Equipment recently installed in an automobile plant for simultaneously milling the four bosses of connecting-rods is shown in the accompanying illustrations. This equipment consists of a Cincinnati "Hydromatic" milling machine provided with a pair of special spindle carriers. Each of these carriers has two spindles on which inserted-blade end-mills are mounted.

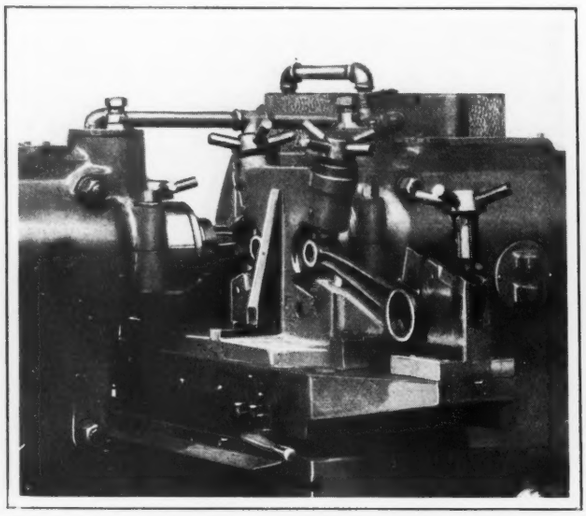


Fig. 1. Milling the Four Bosses of Automobile Connecting-rods Simultaneously

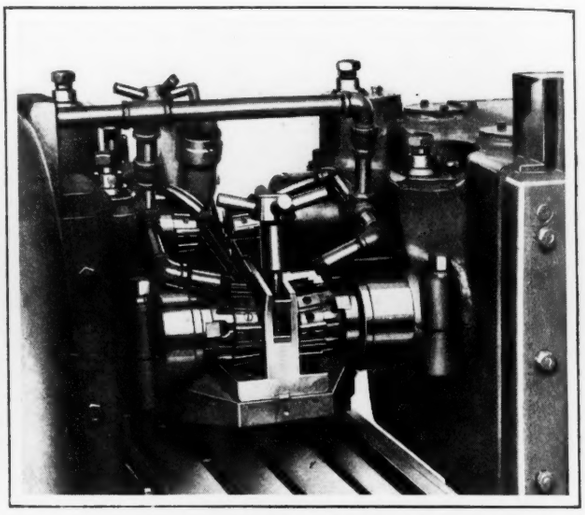


Fig. 2. Construction and Location of the Four Inserted-blade End-mills

Fixtures located at opposite ends of a special index base are employed to hold the connecting-rods securely for the operation. While a connecting-rod held in one fixture is being milled, the opposite fixture is reloaded. At the completion of the cut on the rod in the milling position, the table is automatically returned at a rapid rate to the starting position. Then the fixture base is indexed by hand, after which the table automatically advances rapidly to bring the new connecting-rod into line with the milling cutters. The table next trips automatically into the feed rate for milling all four bosses on the rod at one time. Convenience in loading and rapidity of operation are obtained by this method. Details of the fixture are shown in Fig. 3.

Approximately 3/32 inch of stock is removed from each boss of the steel connecting-rod forgings in this operation, and on the large end, the boss faces are held to size within plus or minus 0.002 inch. Two of the shell end-mills used are 3 inches in diameter, while the other two are 5 inches in diameter. A table feed of 6.92 inches per minute is employed, which gives a production time per piece of 0.88 minute, or an average production of 68 pieces per hour.

* * *

It is estimated that the grinding wheel manufacturers of this country produce about $30,000,000 worth of grinding wheels annually. Of this, the automotive industry uses at least $12,000,000 worth.

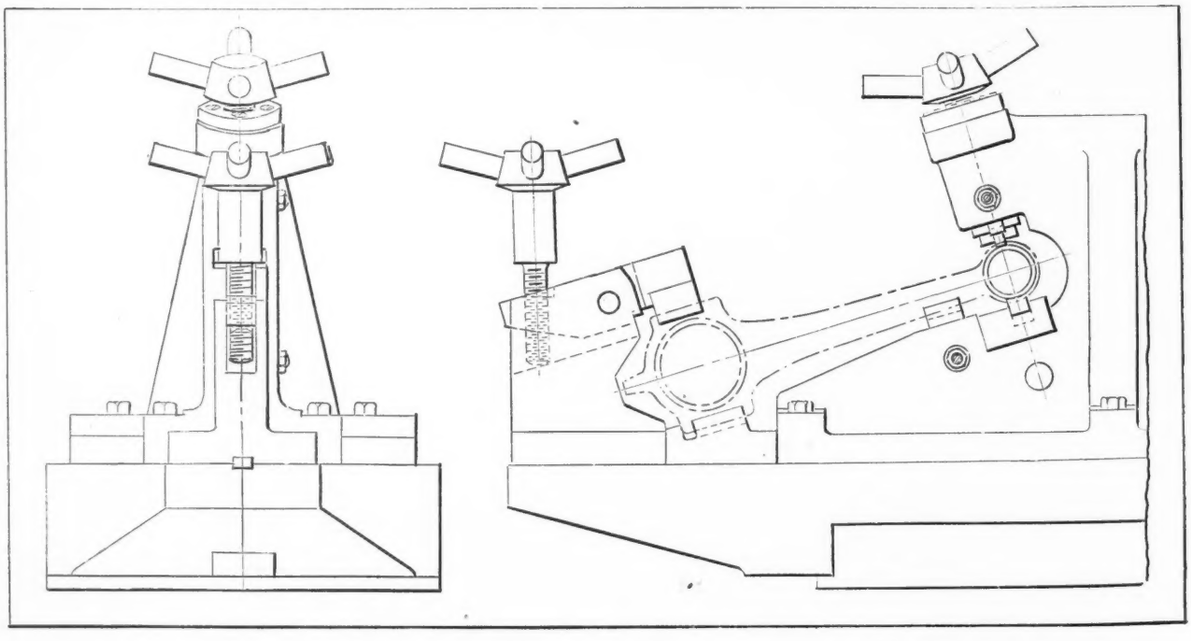


Fig. 3. Construction Details of Special Fixture for Holding Connecting-rods while Milling Four Bosses

Production Tools for the Turret Lathe

Special Tooling Equipment Employed for Machining Cast-iron Stuffing-box Glands on a Production Basis

By JOSEPH E. FENNO

THE special tool equipment here described is used on a turret lathe for machining cast-iron stuffing-box glands like that shown in Fig. 1. The first operation consists of rough- and finish-turning the outside diameter, rough-boring the shaft hole, and beveling the end on a turret lathe, employing the equipment shown in Fig. 2.

The gland is held in a two-jaw universal chuck *J*. To the latter is secured the adapter *K*, the shank of which is held in the turret. A similar chuck is secured to the opposite side of the turret to permit the operator to unload and load one chuck while the work held in the other chuck is being machined. With this arrangement it is unnecessary to stop the machine spindle for reloading. The chucks are equipped with special jaws *I* of the V-type, which locate the glands in the proper position. A three-point support is provided for the work by the three pins *H*.

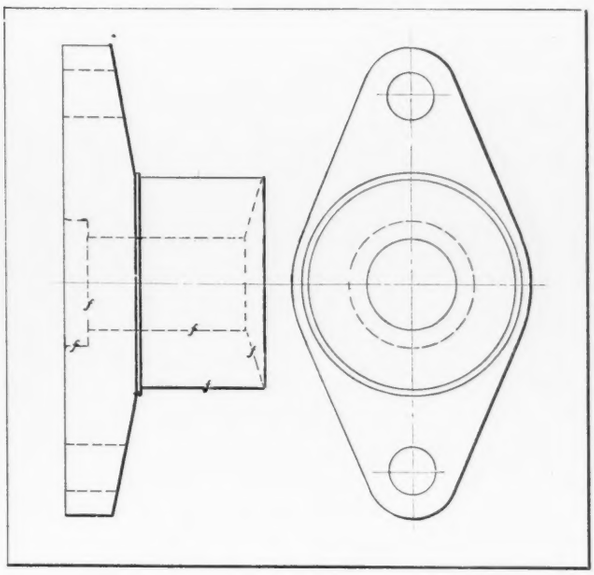


Fig. 1. Cast-iron Stuffing-box Gland

Turning, Boring, and Beveling in One Operation

The cutter-head *A* is secured to the lathe faceplate by four cap-screws,

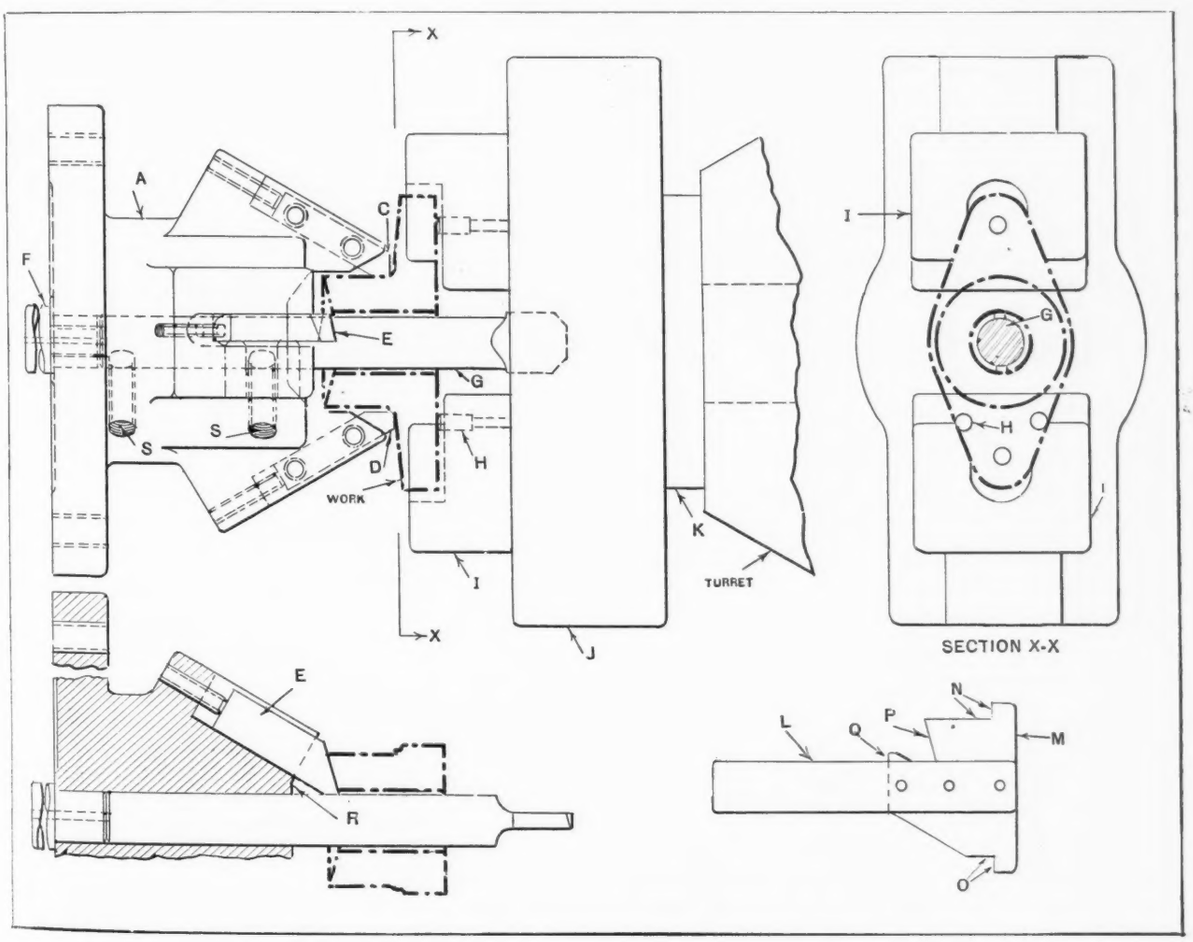


Fig. 2. Special Turret Lathe Set-up for Machining Gland Shown in Fig. 1

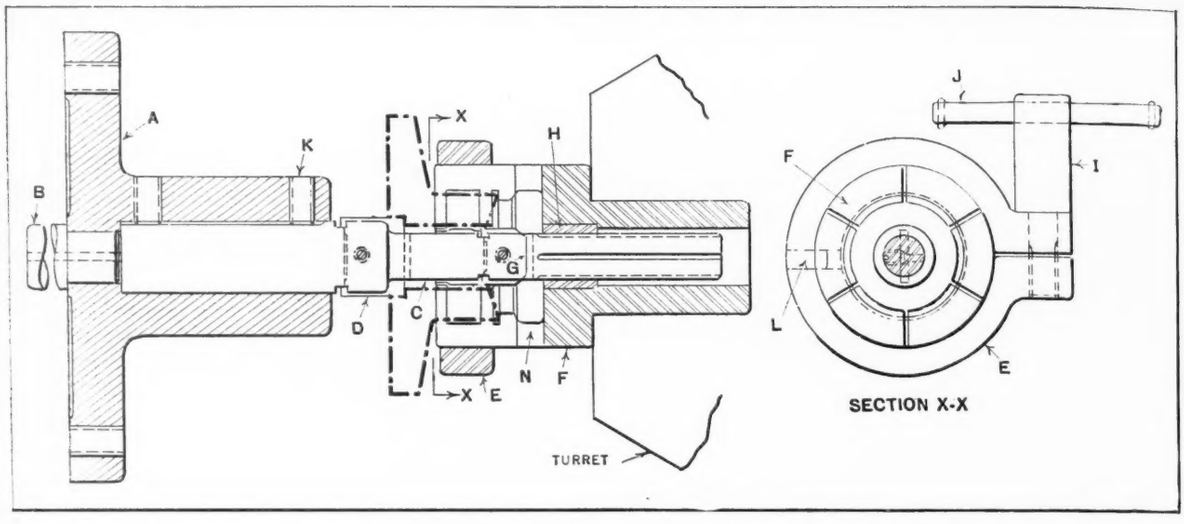


Fig. 3. Tools and Work-holding Fixture for Finish-boring and Counterboring Gland

and is accurately centered by the plug *F* which enters the spindle bushing. The cutter *D*, which rough-turns the outside of the gland, is set slightly ahead of the cutter *C*, which takes the finish-turning cut. The two beveling cutters *E* are set to take the same depth of cut, as no finishing cut is taken on the beveled end. It will be noted that the cutters described are set at an angle and are backed up by adjusting screws. The boring-bar *G* is fastened in the tool-head by two set-screws *S*.

The turning and beveling tools in head *A* are set by means of the gage *M*. In setting the tools, bar *G* is removed and the shank *L* inserted in its place. With the shoulder *Q* held against the surface *R* of the head, the cutters are ground and adjusted to their proper gage surfaces *P*, *N*, and *Q*. The rough-boring bar *G* is made long enough to permit it to pass through the hole in the gland before the other tools begin to cut, thus eliminating any misaligning action as a result of the uneven cutting of the boring tool *G* in the cored hole of the work. A hole is drilled through plug *F* to permit the air to escape when bar *G* or the shank *L* of the gage is inserted in the tool-head.

Finish-boring and Counterboring Gland

The second operation, which consists of finish-boring the shaft hole and counterboring the flange, is performed with the tool equipment shown in Fig. 3. The method of holding the bar *C* on the lathe faceplate is similar to that employed for the holder shown in Fig. 2. The holder *A* is centered by the plug *B*, and the bar fastened securely by two set-screws *K*. The counterboring cutter *D* and the finishing cutter *G* are removable, and can be easily replaced. The gland is gripped by the holder *F* in which it is a slip fit. The large end of the holder is slotted up to the holes *N* in six places. This permits the six segments to be contracted or drawn in so that they clamp the work in place when the screw *I* of the split ring *E* is tightened.

The pin *L*, which is a loose fit in member *F*, holds the split ring in place. The cross-handle *J* is a slip fit in the screw *I*, and can be drawn through to one side in order to give greater leverage. Two holders are provided to permit loading and unloading while one piece is being machined. The holders are secured to the turret and have bushings *H* which guide and support the pilot of the boring-bar.

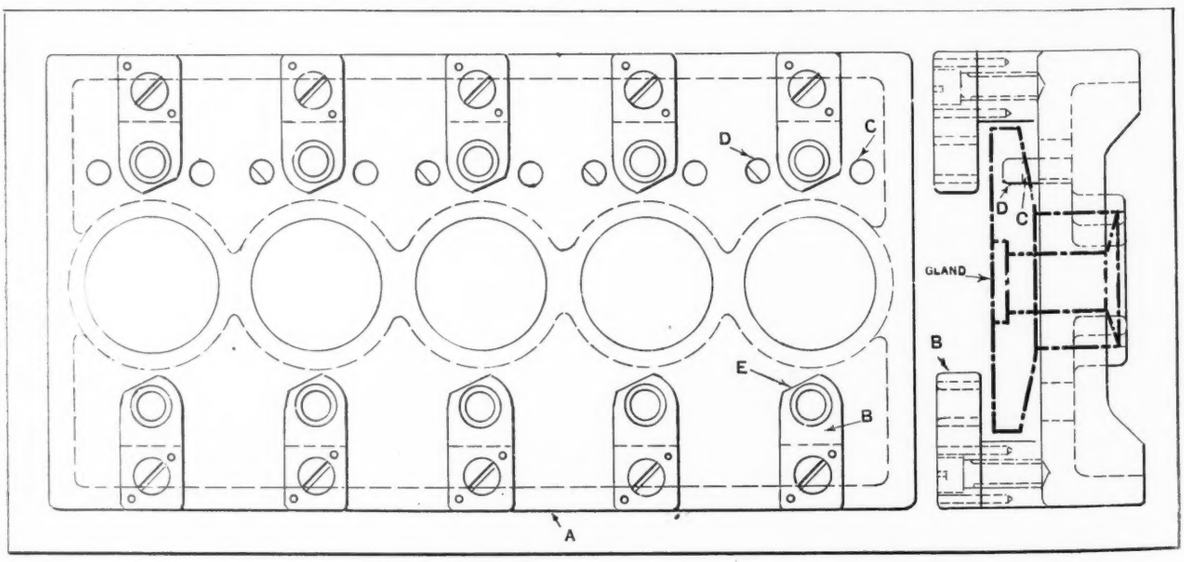


Fig. 4. Fixture Used on Multiple-spindle Drill for Drilling Flanges of Gland

Drilling the Flanges of Glands

In Fig. 4 is shown a jig employed in drilling the flanges of the glands. The drilling operation is performed on a multiple drilling machine. The jig shown is of simple and inexpensive construction, and permits the work to be quickly and easily removed or located for drilling. In the jig are five bored holes, each of which receives the large turned end of one of the glands. The five glands are placed in the jig with their flanges at an angle and resting on the pins *C*. They are then swung around against pin *D* and dropped down between the two pins where they become properly seated. The drill bushing plates *B* are beveled at *E* to provide clearance for the glands when placing them in the jig. The pins *D* are also beveled for the same reason.

* * *

DIAL INDICATING GAGES

By C. S. HAZARD

On page 201 of November MACHINERY is described an ingenious fixture for gaging the inside diameter and the interior surfaces of a small casting by means of a pair of dial gages. This appears to be a very practical fixture, but it has one disadvantage which it may be well to call to the attention of the reader.

In using this gage to measure the part shown, the work is hung on two supporting pins *N*. The variations in diameter are shown by a dial gage actuated by a lever *Q*, which bears against a third point on the work. At first glance, this manner of locating the work appears to be in conformity with the general principle that a three-point support is the ideal method of locating or holding a round piece.

A little consideration will show, however, that as neither of the supporting pins *N* is directly opposite the gaging lever *Q*, a variation of 0.001 inch in the diameter of the piece will not displace the end of *Q*, 0.001 inch. As the pins *N* are about 60 degrees off center each way, the end of lever *Q* will move 0.0015 inch for each 0.001 inch variation in the diameter of the piece being gaged. As the lengths of the two arms of lever *Q* appear to be in the ratio of 1 to 2, an error of 0.001 inch on the diameter of the part would show on the dial gage as about 0.003 inch. This is a very unhandy scale to use, when the time comes to translate readings of the dial into corrections in the setting of the cutters which produce the part.

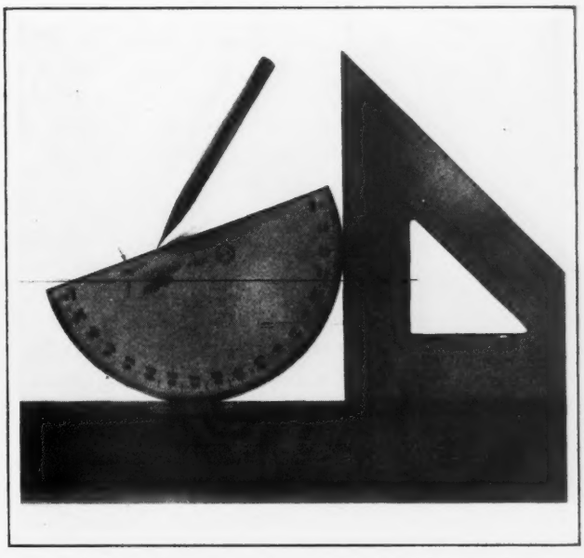
Whenever possible, dial-gaging fixtures should be so constructed as to indicate directly the number of thousandths of an inch correction needed on the tools to bring the work to the standard dimension. In the case of the present fixture, it would be impractical to place one of the pins *N* opposite the gaging point, on account of the difficulty of centering the piece accurately on the gage. A more practical method would be to place the two pins *N* 30 degrees each side of the center line, that is, 60 degrees apart, and to make the arms of lever *Q* in the ratio of 0.539 to 1. This would provide a solid support for the work, keep it on center, and cause the dial gage to read 0.002 inch for every 0.001 inch error in the diameter of the work.

LAYING OUT ANGLES WITH DRAFTSMAN'S SEMICIRCULAR PROTRACTOR

By J. E. CLARK, Jr.

The usual method of drawing oblique lines at a given angle with the aid of an ordinary draftsman's protractor is a rather tedious procedure. This is especially true when a large number of oblique lines at different angles are required. The accompanying illustration shows a method of drawing lines at a given angle that the writer believes is more convenient and rapid than the method ordinarily used. A short line is scribed on a triangle at a distance from the lower edge equal to the radius of the outside edge of the protractor. This line may be produced with a sharp knife or with an old razor blade, and afterward filled in with India ink.

To draw a line at an angle of 20 degrees with the horizontal and through a given point, the protractor and triangle are placed against the upper



Method of Drawing Lines at Angle with Base Line

edge of the T-square, as shown in the illustration. The protractor is then moved around so that the 20-degree division coincides with the mark on the triangle. Holding both the protractor and the triangle in this position and in contact with the T-square, slide them along until the straight edge of the protractor passes through the given point. The line is then drawn in the required position, using the edge of the protractor as a guide for the pencil. The same procedure is followed in drawing a line at any other angle. In drawing a line that slopes in the opposite direction, it is only necessary to reverse the position of the triangle and protractor.

* * *

The methods of modern engineering exemplify industry's growing distrust in the old so-called "practical" methods. Industry expresses its faith in practical *theory* by the millions it spends in scientific research. Fundamental laws are the tools we must use in order to make progress. We need practical theory for the same reason that we need reference books— for the purpose of systematizing experience.

Deflection of Springs by Moving Weights

Chart for Determining the Amount of Deflection of a Helical Compression Spring in Bringing a Moving Load to Rest

By J. W. ROCKEFELLER, Jr., Consulting Engineer, New York City

THE accompanying chart has been prepared for use in determining the amount a helical compression spring is deflected in bringing a moving weight to rest. It is assumed that the spring is used in a horizontal position and that the weight is traveling in a horizontal path. The vertical lines in this chart represent the deflection of a spring under static load, that is, the amount the spring is deflected when in a vertical position with the weight simply resting upon it. This deflection is given in inches.

The oblique lines represent the velocity at which the weight is traveling, in feet per second. The horizontal lines give the horizontal deflection of the spring, in inches. When the spring is used in a vertical position, an approximation of its deflection may be obtained by adding the kinetic deflection obtained from the chart to the static deflection of the spring when the weight rests upon it. This approximation becomes very close as the deflection due to kinetic energy becomes large in proportion to the static deflection.

In determining the amount a spring will be deflected under a falling weight, the velocity V of the weight, upon striking the spring, may be taken as $\sqrt{64.4 \times h}$. In this formula, h represents the distance, in feet, through which the weight falls. If h is large, compared to the static deflection of the spring under load, the total deflection obtained by adding the static and kinetic deflections may be taken as correct. The application of the chart will be illustrated by examples.

Example 1—Two springs made of 1-inch round steel and having a mean coil diameter of 5 inches, with a free height of 12 inches and a solid height of 6 inches, are to be used as bumper springs. The deflection f per inch of solid height under a load of 100 pounds is 0.01 inch. This deflection is obtained from the chart Fig. 1 on page 493 of March MACHINERY, or it may be calculated by applying a suitable formula. The fiber stress s under a load of 100 pounds is, according to this chart, approximately 1200 pounds per square inch. Now the fiber stress S under a load of one ton, assuming the two-ton load to be equally divided between the two springs, equals $1200 \times 20 = 24{,}000$ pounds per square inch.

Suppose that the two springs are to absorb the energy of a load of two tons moving in a horizontal direction, at a speed of 6 feet per second. The problem is to determine the amount of deflection of the springs and the maximum fiber stress of the material, assuming that the torsional modulus of elasticity G of the material equals 11,500,000. Now the static deflection F of the spring is:

$$F = f \times \frac{SH \times W}{G_1 \times 10}$$

in which

f = deflection per inch of solid height of spring under a load of 100 pounds;

SH = solid height of spring;

W = static load, in pounds;

G_1 = torsional modulus of elasticity, in millions.

Substituting numerical values in this formula, we have

$$F = 0.01 \times \frac{6 \times 2000}{11.5 \times 10} = 1.04 \text{ inches}$$

which is the deflection of each spring under a static load of 2000 pounds. Now if the velocity V of the falling weight is 6 feet per second, the total deflection equals 3.7 inches, according to the accompanying chart.

In finding this deflection, we first locate 1.04 at the bottom of the chart in the space designated "Deflection of Spring under Load (Static)," and follow the vertical line up to the point where it intersects the diagonal line representing a velocity of 6 feet per second. From this point we follow the horizontal line to the left-hand side of the chart where the total deflection 3.7 is obtained in the column designated "Deflection of Spring under Falling Weight (Kinetic)."

Now for the maximum fiber stress we have,

$$\frac{3.7}{1.04} \times 24{,}000 = 85{,}400 \text{ pounds per square inch}$$

Example 2—A spring is coiled from No. 10 Washburn & Moen gage wire. Its outside diameter is 1.25 inches and its solid height is 3 1/2 inches. The static deflection F of the spring under a load of 20 pounds, assuming the modulus of elasticity to be 11,500,000, is 1.52 inches. The maximum fiber stress S in the steel equals 22,000 pounds per square inch, and the mean diameter D is 1.115 inches.

Assume that the weight of 20 pounds, instead of being a static load, is dropped upon the spring from a height of 2 feet. Find the deflection of the spring and the fiber stress in the material. As the velocity $V = \sqrt{2gh}$ in which g is the acceleration due to gravity, and h the height from which the weight is dropped, we have $V = \sqrt{2 \times 32.16 \times 2} = 11.3$ feet per second. As the static deflection equals 1.52 inches and the velocity equals 11.3 feet per second, the kinetic deflection is found from the accompanying chart in the following manner: Locate 1.52 at the bottom of the chart and follow the vertical line upward to the point where it intersects the diagonal line representing a velocity of 11.3 feet per second (estimated). Then follow the horizontal line to the column at the left, where the deflection of the spring under the action of the falling weight will be found to be 8.5 inches. As

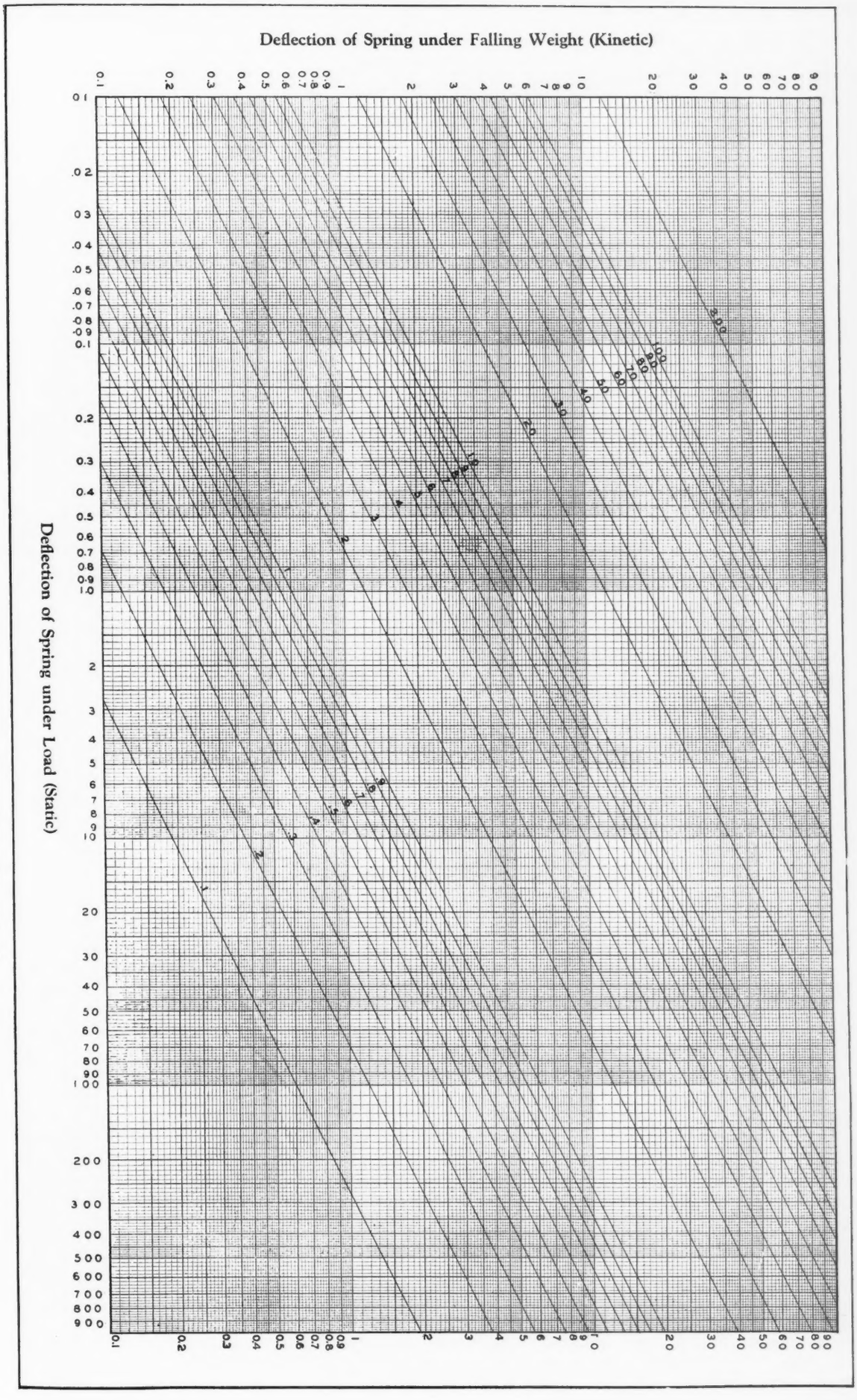


Chart Giving Deflection of Helical Spring Actuated by a Moving Load

the spring is used in a vertical position, the total deflection will equal

$$8.5 + 1.52 = 10.02 \text{ inches}$$

The fiber stress S developed under the action of the falling weight equals

$$22{,}000 \times \frac{10.02}{1.52} = 145{,}000 \text{ pounds per square inch}$$

* * *

ELECTRIC FURNACES FOR COPPER BRAZING

Electric furnaces have recently been developed for copper-brazing steel parts together. According to a paper read by A. N. Otis and W. L. Warner, of the General Electric Co., before the Western Metal Congress, this process requires an atmosphere of protective gas in the furnace, for which hydrogen in pure form, or diluted with nitrogen, is suitable.

The parts to be brazed together are held by their fits or by means of tack welding, if necessary, and copper wire or copper chips are placed adjacent to the joints to be brazed. When heated to a brazing temperature, the chemical action of the hydrogen cleans all the surfaces thoroughly, thus performing the function of a flux, in addition to its primary function of excluding air from the furnace.

The capillary action of the fluid copper causes it to spread over these cleansed surfaces, and to be drawn into the most minute joints between the parts. Furthermore, copper and iron are slightly soluble in each other under the conditions existing, which results in an alloyed or welded joint that is exceedingly strong.

By this process, it is possible to unite a large number of separate pieces into an assembly at one operation, as, for example, the blades of a turbine wheel. Designs of many machines will undoubtedly be modified to take advantage of this unique method of joining when its merits have become better known; for while the process has been known for some years, it is only recently that the apparatus and the technique have been developed to practice it on a large scale.

The work must be cooled in the protective atmosphere well below red temperature in order to avoid oxidation, and this requires a cooling chamber contiguous with the furnace.

This process can, without doubt, be applied in many lines of manufacture, as it makes feasible the assembly of parts that would be difficult or impossible to assemble by other means. Designs can be modified so as to be able to take advantage of this method at substantial savings in cost. The copper brazing process, for example, has been made use of in brazing the new cutting alloy Carboloy to steel shanks.

Developing Foreman Leadership

It is becoming more and more recognized that many of the problems of management can be solved in a satisfactory manner only through the intelligent cooperation of the foreman. This is especially true of most of the problems in the relations between employer and employe; and as corporations grow larger this becomes more important. The article "How Foremen's Conferences Develop Leadership" in May MACHINERY, will deal with the development of leadership in the foreman, showing how foremen's conferences, when properly organized, give each foreman in a plant the benefit of the training and experience of all the others. There never was a time when leadership was needed to so great an extent as at present, and progressive industrial plants must take steps to develop the quality of leadership in their foremen if they expect to obtain the best results in operation and personnel relations.

CHROMIUM-PLATING WRENCHES

All "Superrenches," manufactured by J. H. Williams & Co., Buffalo, N. Y., are chromium-plated to give them an attractive appearance, which lasts indefinitely, due to the unusually high resisting qualities to tarnish and rust, that this plating possesses. It has been the experience of the company mentioned that wrenches and other tools that are merely nickel-plated, lose their finish to such an extent, if kept in stock for a year or so, that they must be refinished. By chromium-plating the wrenches, this difficulty has been eliminated.

After these wrenches have been forged from chrome-molybdenum steel and passed through the various machining and heat-treating processes, they are sand-blasted with a fine-grit sand to give them uniform color and even surfaces. Then they are transferred to the polishing department, where the heads are buffed bright, but the handles are not touched. Next, they are thoroughly cleaned by scrubbing them in a commercial cleansing compound.

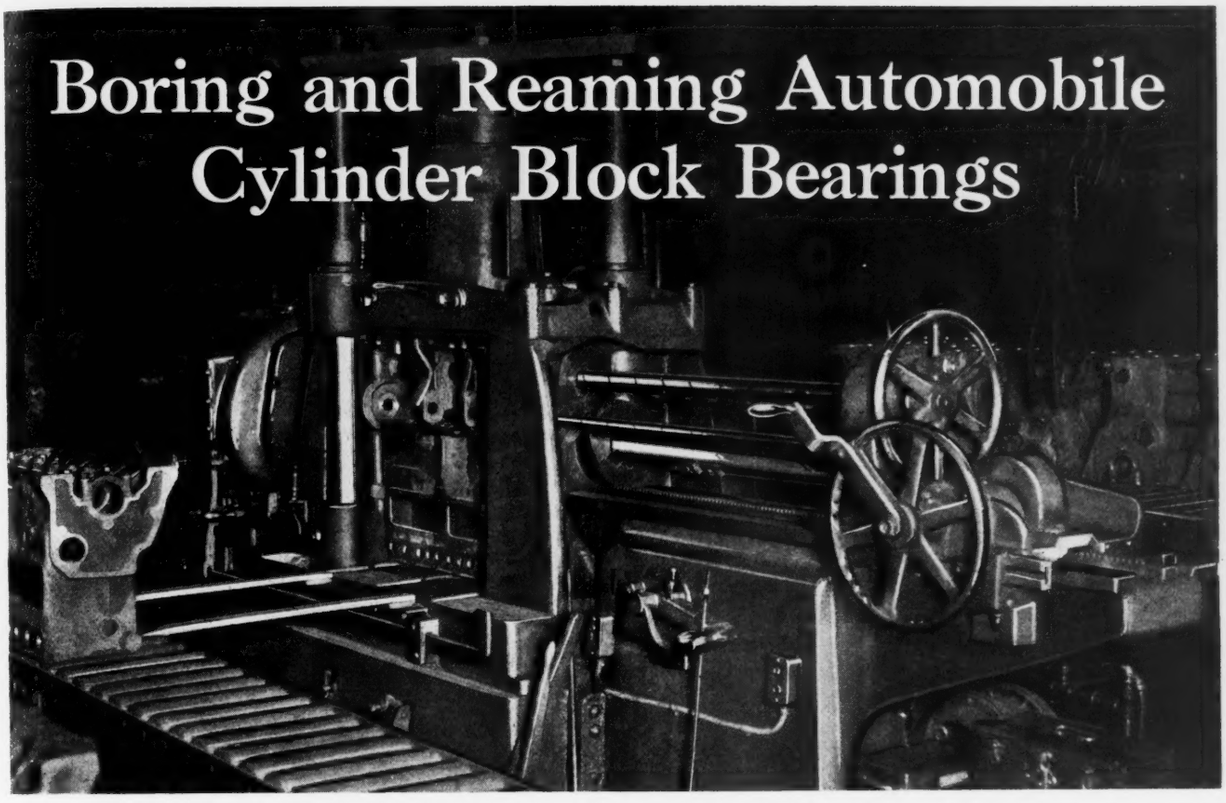
Copper is then deposited all over the wrenches by the electroplating process in an amount just sufficient to give a color flash. The wrenches are next nickel-plated by immersing them in a plating tank for approximately one hour, after which the faces of the wrench heads are again buffed. Finally, the wrenches are chromium-plated all over. For this process, they remain in the plating tank from four to five minutes, and receive a light flash of chromium. The wrenches are suspended in the plating bath by means of spring clips which are expanded inside the jaws where lack of chromium does not matter.

The chromium-plating tank was made to specifications supplied by United Chromium, Inc., and is of conventional design. It is approximately 6 feet long, 2 1/2 feet wide, and 3 feet deep, being constructed of 1/4-inch steel plate and having an 8-pound chemical sheet lead lining.

Chromium-plating operations are carried out at a maximum temperature of from 118 to 120 degrees F., which is controlled by an automatic thermostat. The bath is heated by steam forced through antimony-lead coils immersed in the bath, and is kept cool by the same coils. Fumes arising from the bath are drawn off through ducts arranged around the sides of the tank. Direct current of from 3 to 12 volts is obtained for the plating by means of a generator set. ("Superrenches" have been described in articles appearing in the October, 1927, January, 1926, and December, 1925, numbers of MACHINERY).

In addition to these wrenches, the company chromium-plates special forgings, including parts for oil-field equipment.

Boring and Reaming Automobile Cylinder Block Bearings



Modern Methods Employed at the Graham-Paige Motors Corporation in Machining the Crankshaft and Camshaft Bearings of Cylinder Castings

EXTENSIVE changes in manufacturing methods resulting in higher production rates, reduced costs, and increased quality have been instituted by the Graham-Paige Motors Corporation, Detroit, Mich. In the cylinder department of this plant, for example, modern machines have been installed for each operation. The present article describes the methods and equipment employed in boring and line-reaming the crankshaft and camshaft bearings of the cylinder castings.

Three boring operations—rough, semi-finish and finish—are performed on the crankshaft and camshaft bearings prior to the final line-reaming. All three boring operations are carried out in machines of the types shown in the heading illustration and in Fig. 1, which were built by the W. F. & John Barnes Co., Rockford, Ill. These machines are provided with Oilgear equipment for raising and lowering the tables on which the work is placed and for feeding and withdrawing the boring heads. All

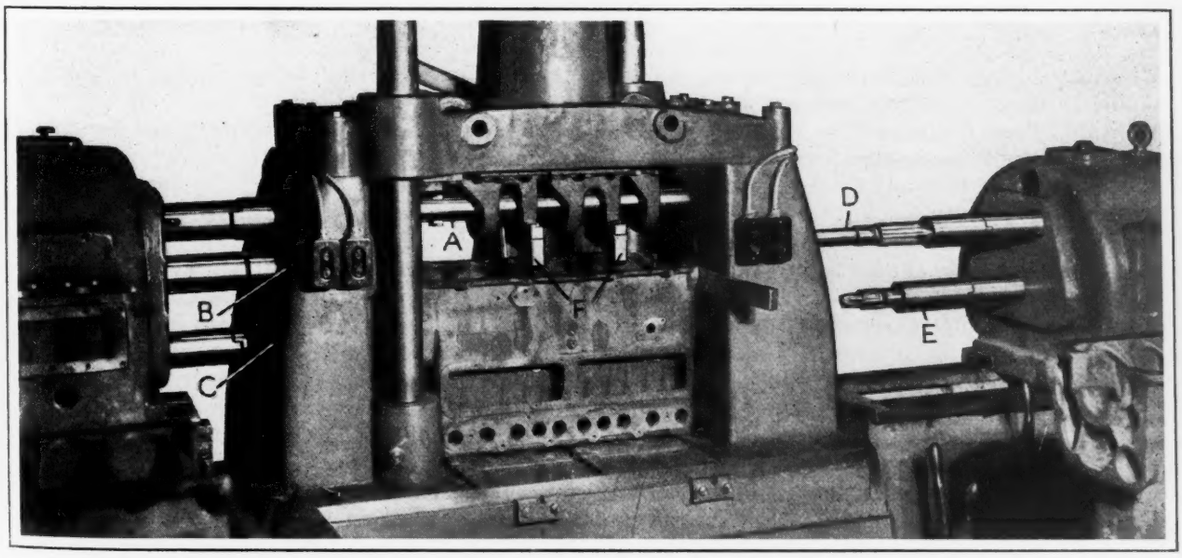


Fig. 1. Hydraulically Operated Machine Employed in Rough-boring the Crankshaft and Camshaft Bearings of Automobile Cylinder Blocks

boring-bars remain connected to either the headstock or the tailstock. Cylinder blocks are conveniently slipped into each machine, as is apparent in the heading illustration, from a roller conveyor which passes by all the machines in the cylinder department.

The Rough-boring Operation

The rough-boring operation on the bearings is performed in the machine shown in Fig. 1, before the main bearing caps are assembled to the cylinder blocks. This machine is provided with two power-driven heads for feeding the cutters, both heads being withdrawn, as shown, for loading and unloading the cylinder castings. The cylinder castings rest on hardened steel strips on the table, and are automatically located when the table is raised by the Oilgear equipment, dowel-pins fastened to the table entering two holes drilled in the crankpan contact surface of the cylinder castings. When the table has been raised against stops, both boring heads commence feeding. The table is started moving by merely depressing a push-button.

Rough-boring of the main or crankshaft bearings is accomplished with cutters held in the Kelly reamer-bar *A*, which is driven by the left-hand head and is adequately supported by four bushings. Actuated by the same head, are two shorter bars—bar *B* for boring the extreme left-hand camshaft bearing, and bar *C* for boring a hole to receive a Welch plug. On the right-hand head there are two boring-bars, one of which, bar *D*, carries tools for boring the remaining two camshaft bearings; the other bar *E* carries a cutter for boring a second Welch plug hole on the right-hand end of the cylinder casting.

Bar *D* is well supported during the operation by bushings contained in arms *F* and in the right-hand upright of the fixture. Feeding of the first cutter on bar *D* through the unfinished camshaft bearing at the extreme right presents no difficulties, since the bearings machined by the cutters of this bar are of two different diameters. At the end of the operation, the two heads automatically withdraw, and the table is again lowered into the position shown. About 1/8 inch of stock on each side, or 1/4 inch on the diameter, is removed from the crankshaft bearings in this operation.

Fixture Speeds up Assembly of Bearing Caps

After the rough-boring operation just described, the main bearing caps are assembled to the cylinder casting, so that both the bearings proper and their caps may be finished together. This assembling operation has been greatly expedited through the use of the fixture shown in Figs. 2 and 3, which is positioned directly above the roller conveyor. Before the cylinder castings come to this fixture, the bearing caps are placed in their respective positions on the castings and the studs are entered loosely into the tapped holes provided for them, as shown in Fig. 2.

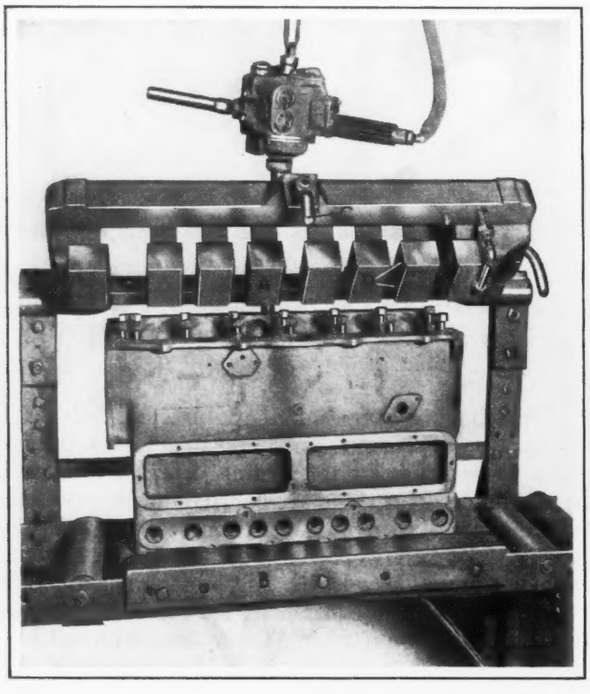


Fig. 2. Fixture which Facilitates the Accurate Assembly of the Main Bearing Caps to Cylinder Castings

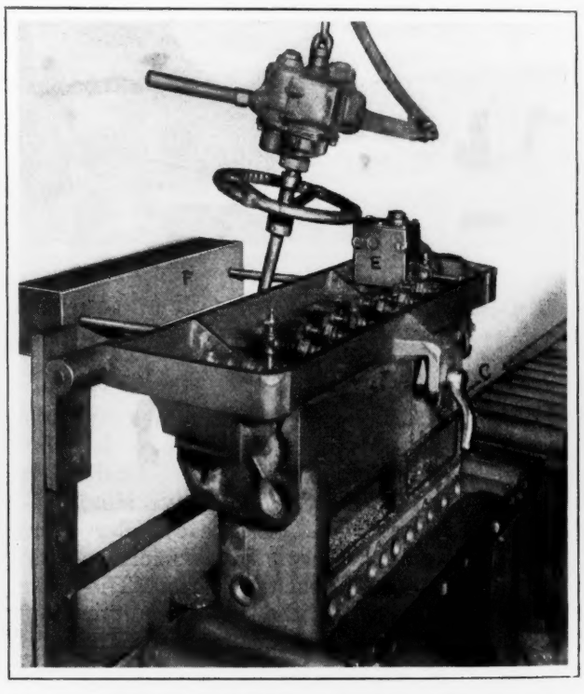


Fig. 3. Illustration of the Fixture Shown in Fig. 2, in the Lowered Position on a Cylinder Casting

It will be seen that the fixture has eight finished blocks *A* which are slightly less in width than the required distance between the faces of the respective bearing caps. After a cylinder block has been positioned sidewise beneath the fixture by angle-iron guards *B* at the front and rear, the fixture is lowered on the cylinder block, as shown in Fig. 3, to bring blocks *A* between the bearing caps and thus locate them approximately. The fixture is locked readily to the cylinder casting by turning handle *C*, which brings a cam-shaped clamp in firm contact with a flange extending around the top of the cylinder casting as positioned beneath the fixture.

In the inner face of each end-block *A*, Fig. 2, and in each face of the intermediate blocks, there are

two plungers *D*, which provide a means of positively locating each cap on the cylinder casting and of holding it securely while the studs are being driven in place. These plungers are forced against the bearing caps after the fixture has been lowered on the cylinder casting, by oil pressure exerted through the hand-pump *E*, Fig. 3. The oil under pressure is supplied to the various plungers through the piping seen in the illustration. Each plunger bears one-half on a cap and one-half on the adjacent surface of the cylinder casting, and four plungers bear against each cap, two on each side.

An air drill, suspended overhead as shown, drives the studs quickly and firmly on the caps. Raising and lowering of the fixture is facilitated by a counterweight *F* at the back. In addition to saving much time, this fixture insures accurate assembly of the bearing caps. (Detailed information concerning the machining of the bearing caps was contained in an article published in September, 1928, MACHINERY, page 21.)

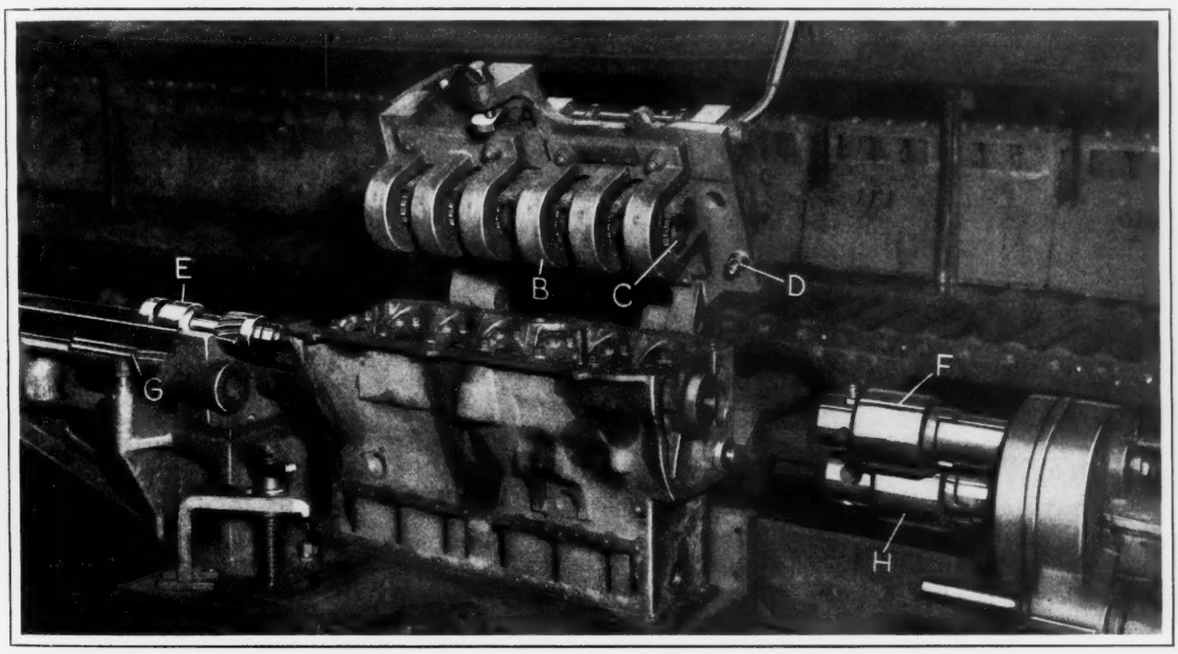


Fig. 4. Line-reaming Operation in which a Fixture of Unusual Design Saves Much Time and Effort

Semi-finish- and Finish-boring Operations

The machine employed for the semi-finish-boring of the crankshaft and camshaft bearings is of the type shown in the heading illustration, which has a power-driven head at the left-hand end and a hand-operated tailstock at the right-hand end. When a push-button is depressed, after a cylinder casting has been slipped into the fixture, the table rises until it reaches a stop, after which the tailstock is advanced to carry the boring-bars and tools through the various bearings until they become automatically connected to the driving spindles of the headstock.

During this movement of the tailstock, the axes of the bars are slightly offset from the centers of the bearings which they are to machine, so as to permit the fly cutters carried by the bars to clear the bearing surfaces. When the boring-bars have been connected to the driving spindles as described, the table rises a second time, but only a slight amount, so as to bring it into position for cutting the desired amount of stock from the bearings.

In this operation, the semi-finish cuts are taken on the crankshaft and camshaft bearings with tools mounted in Kelly reamer-bars, and two generator pads are rough-machined on the rear of the cylinder casting with tools mounted on a third bar which is considerably heavier than the other tool. About 3/32 inch of stock on the diameter is taken from the crankshaft bearings in this operation. When it has been completed, the table drops slightly to permit the tools and boring-bars to be withdrawn by sliding the tailstock to the right after the bars have been disconnected from their driving spindles. Then the table drops into the unloading position.

Finishing of the crankshaft and camshaft bearings, and of the generator pads, is performed in the machine shown in the heading illustration, in an operation that is identical to the semi-finishing operation, with the exception of the amount of stock removed. About 0.020 inch of metal on the diameter is taken from the bearings. One of the principal advantages of all three boring operations described is the small amount of time that elapses between the loading of the cylinder castings and the starting of the cutting action.

Line-reaming Operation Possesses Unusual Features

In many automobile plants, the line-reaming of the crankshaft bearings in cylinder castings requires considerable time, due to the practice of assembling the different cutters on the reamer-bar by hand as the bar is advanced through the respective bearings. At the Graham-Paige plant, the fixture shown in Fig. 4 eliminates this hand assembly of the cutters and substantially reduces the line-reaming time.

After the cylinder casting has been located on dowel-pins mounted on the table of the reaming machine, the fixture is swung forward and clamped

to the top of the cylinder casting by swiveling the cam-clamp *A* under the flange on the crankcase portion of the casting. When the fixture is in that position, the six arms *B* extend between the various crankshaft bearings, and bring cutters *C* in line with these bearings. The cutters are held securely in the arms between bronze half-bearings and rubber pads which do not destroy the cutting edges. In the lowered position, the fixture is located accurately on the cylinder casting by two dowel-pins *D* which enter holes in the casting.

When the fixture has been lowered and clamped, the reamer-bar *E* is pushed forward by hand, the cutter on its front end and the bar itself passing through the six cutters *C* until the front end of the bar reaches the flexible driving coupling *F*, which is mounted on the power-driven head of the machine. Cutters *C* have internal pins which slide along a keyway in bar *E* and finally enter grooves at right angles to the keyway, which serve to drive the cutters.

Reamer-bar *G* is next passed through the camshaft bearings and attached to the flexible coupling *H*, which is also contained on the power-driven head of the machine. The passing of bar *G* and its cutters through the camshaft bearings is conveniently accomplished, as these bearings vary in diameter. Finally, the rubber pads which hold cutters *C* in place are released by operating a handle, leaving them free to revolve as bar *E* is rotated and pulled toward the right simultaneously with bar *G*. The cutter on the forward end of bar *E* machines the right-hand main bearing, while cutters *C* finish the other six.

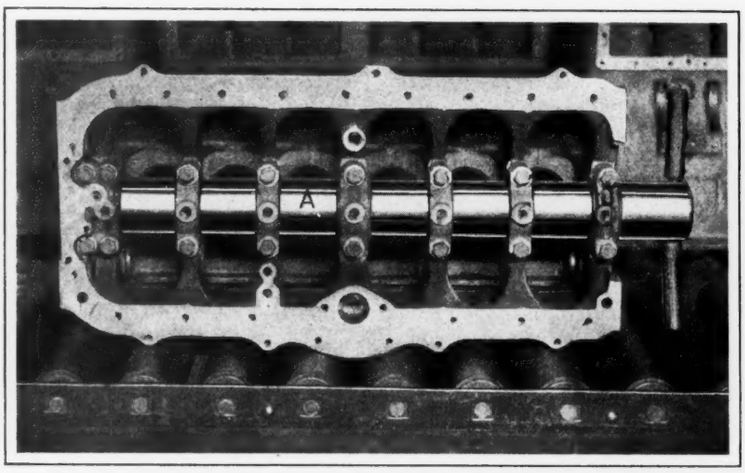


Fig. 5. Checking Alignment of Main Bearings with a Gage Only 0.0005 Inch Smaller in Diameter than the Minimum Diameter of the Bearings

In this line-reaming operation, approximately 0.010 inch of stock is removed on the diameter of the crankshaft bearings, and they must be true to size within a tolerance of 0.001 inch, the maximum and minimum diameters specified being 2.875 and 2.874 inches, respectively. At the end of the reaming, cutters *C* are again gripped securely between the bronze bearings and rubber pads to prevent their shifting axially or radially as bar *E* is withdrawn. The machine employed for this operation was built by the Rockford Drilling Machine Co.

Checking Main Bearings for Alignment

Alignment of the seven crankshaft bearings is checked by means of the plug gage *A*, Fig. 5. This gage has a diameter only 0.0005 inch less than the minimum diameter specified on the bearings, this allowance providing a sliding fit. Before cylinder castings pass inspection, this plug gage must be extended through all seven crankshaft bearings. The gage is approximately 30 inches long.

HEALTH PRECAUTIONS IN CHROMIUM PLATING

During the last few years, the use of chromium plating has increased rapidly, and it is now being extensively employed for finishing metal parts, such as automobile accessories and plumbing fixtures, because of its high luster and resistance to tarnish, and for printing plates, gages, tools, and dies, on account of its great hardness. The bath used for chromium plating consists principally of chromic acid. During the plating process, considerable quantities of hydrogen and oxygen are liberated, carrying a spray of chromic acid into the air. These facts have prompted the United States Public Health Service to make a study of health hazards in the chromium plating field. The conclusions arrived at are summarized in the following.

It was found that exposure to very low concentrations of chromium acids, as, for example, one-sixtieth of a grain in 350 cubic feet of air, which may be considered approximately the volume of air breathed by a worker in eight hours, is sufficient to cause nose bleed and nasal inflammation in a week's time or less. Higher concentration of chromic acid, or longer exposure, may cause complete perforation of the nasal septum. This is painless, however, and the operator may be entirely unaware of the perforation. Many of the employes were found to have chromium ulcers on the hands or on other exposed parts of the body. No evidence was found, however, of injury to the respiratory tract, with the exception of the effects on the nose, nor of any harm to the digestive system or the kidneys.

While, therefore, the effects of the acids from chromium plating on the health are not of the most serious nature, they can be entirely eliminated by suitable measures. These include an adequate system of ventilation, by means of which the air is drawn horizontally across the plating tanks into a narrow duct, in which the air velocity should be about 2000 feet per minute. As far as possible, rubber gloves, aprons, and shoes should be worn. Frequent applications of vaseline or mentholatum salve to the nose and hands greatly reduce the danger of ulceration. All cuts and abrasions of the skin should immediately be given medical treatment.

If these simple and entirely practicable measures are taken, any danger from the effect of chromic acid can be practically eliminated, and there will be no reason to be apprehensive of the effects on the health of the worker from the increased use of chromium plating in the industry.

Notes and Comment on Engineering Topics

Of the $5,000,000,000 spent by the railroads of the United States for improvements in equipment, roadway, and structures during the last six years, $600,000,000 was expended for locomotives, $1,-450,000 for freight cars, and $264,000,000 for passenger cars; $218,000,000 was spent on shops and engine houses.

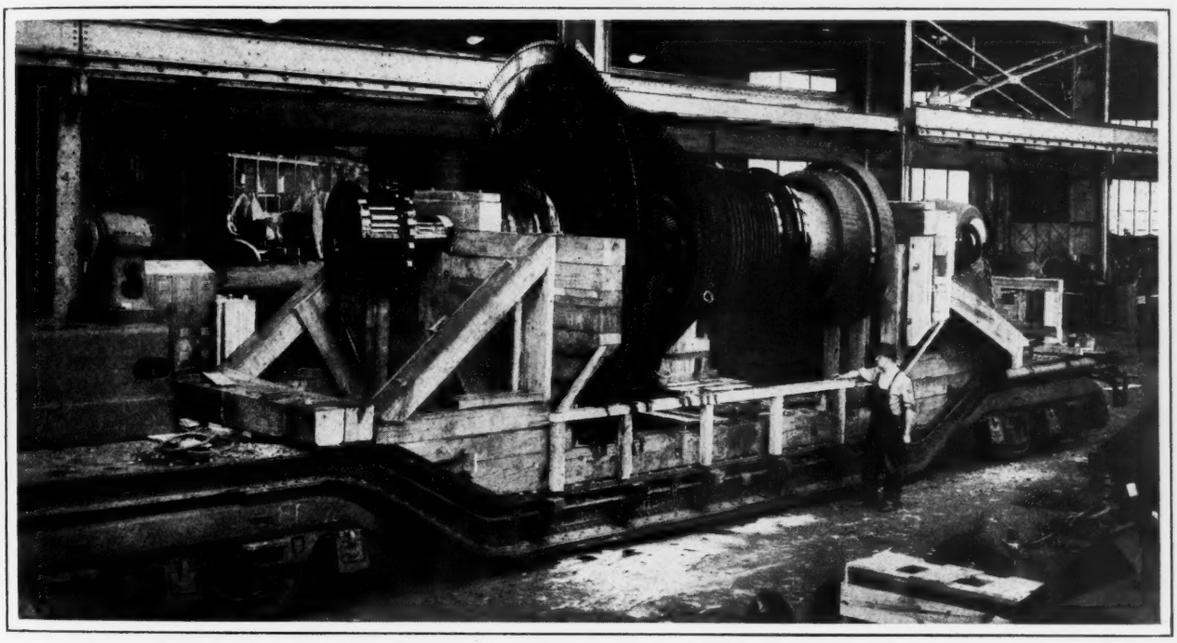
By a process developed in Germany, it is claimed that sheets of metal can be produced so thin, that they are transparent, making it possible to read ordinary type through them. The sheets are formed by the electrolytic method, the metal being deposited on the surface of a soluble substance that can be melted afterward without injury to the metal deposit. Iron, nickel, gold, silver, and platinum have been deposited by this means, and it is stated that sheets so thin have been produced that it takes 2,500,000 of them to make a pile 1 inch thick.

A traffic signal that is set in motion by the blast of the horn of an approaching automobile—that is, by sound waves—has been devised by Charles Adler of Baltimore, according to *Public Safety*. It has been provided, as the inventor puts it, in answer to the need for something better than the time signal at points in less congested districts where the main artery of travel is intersected by a road carrying a lesser volume of traffic and where, under present conditions, the vehicles are often held up to await the signal "Go" even when the path is clear. Should this device prove effective, it would be of considerable value to vehicular traffic.

More than 810,000 motor vehicles were exported from the United States in 1928, as compared with less than 650,000 in 1927. Some of these cars are exported complete, while others are shipped as parts and assembled in factories scattered throughout the world.

A GIANT TURBINE SPINDLE

Recently the largest turbine spindle, as far as maximum diameter is concerned, ever built by the Westinghouse Electric & Mfg. Co. was shipped from the company's South Philadelphia Works. It was built for the Milwaukee Electric Railway & Light Co. The coupling end of the spindle measured 12 feet 2 inches in diameter across the blades from tip to tip, and the total length of the shaft was 23 feet 11 inches.



Westinghouse Turbine Spindle 24 Feet Long and 12 Feet in Diameter Loaded for Shipment on Special Railroad Car

The problems connected with shipping such a large machine part proved rather difficult to solve, but the difficulties connected with it were successfully overcome. When the spindle was ready for shipment on a special depressed type of car furnished by the Pennsylvania Railroad, the net weight of the spindle loaded on the skid was 110,980 pounds, but it was necessary to load an additional 54,430 pounds of material along the side of the spindle, and wherever space could be utilized, to balance the weight. The loading was so planned that all the additional weight used to balance the car consisted of other parts of the turbine unit. Including timbers, bracing and boxing material, a total load of 191,300 pounds was transported on the special car provided, which had a capacity of 210,000 pounds.

Current Editorial Comment

In the Machine-building and Kindred Industries

TRYING OUT DISCOVERIES QUICKLY

The developments in metal-cutting tools that have rapidly followed one another during the past two years will have a far-reaching effect on the machinery industries. Men closely identified with these developments believe they will be followed by others equally remarkable within the next few years.

Such discoveries will benefit users of cutting metals more quickly if they will help the producers to determine the strength as well as the weaknesses of the new materials. An open minded attitude toward these developments will, in fact, benefit the users more than the makers of the material. It is impossible for the makers to experiment with all the uses for which the new materials may be suitable; but if the users tell the manufacturers frankly what they want to accomplish, try out the new tools on their work and report the results obtained, whether favorable or not, the entire industry will benefit quickly by the information accumulated.

This applies not only to the new metal-cutting tools, but also to new steels and other metals used in machine construction. There are many new developments under way in this important field, and the advantages resulting from new discoveries will become available to everyone engaged in the industry much sooner if the suggestion made above is followed.

* * *

ONCE MORE—FREE SERVICE

At a recent meeting of machinery manufacturers the question of how much engineering service it is good business to give in advance of a sale was discussed, and the following actual experience was referred to:

An inquiry for equipment, the total price of which approximated $7500, included so many requests for information and proposed lay-outs, that it cost one of the bidders nearly $500 to submit his quotation. Complete time studies and considerable drafting-room work were required, and after the prospective customer was furnished with all the desired information, a competitor received the order.

Five or six other manufacturers were asked to quote on the same equipment, and presumably each had to incur approximately the same expense, so that about $3000 probably was spent for engineering service by all the bidders in their efforts to obtain a $7500 order. Considering the whole proposition, this sale was made at a loss to the industry; yet the buyer expressed his opinion that the price of the equipment was rather high.

Most machinery manufacturers believe in rendering liberal service to their customers, but they do not believe in wasteful service. When consulting engineering advice is asked for in connection with a quotation on machine equipment, the prospective customer should be willing to pay for that service entirely apart from the machine.

* * *

CHARGING REPAIR COSTS

In most shops the cost of overhauling and repairing machinery and equipment is charged to the maintenance account—that is, to current operating expense; but this should not be done always. Some repairs should be charged to the maintenance account, but others should be considered as a part of the cost of new plant equipment.

When a broken gear or other machine part is replaced, the repair cost is obviously a current operating expense; but if a machine, the average life of which is estimated at ten years, is thoroughly overhauled after six years' service so that it may be good for, say, eight years more, then the cost of this overhauling is not entirely current operating expense. The total life of the machine has been increased four years by the work of overhauling it, and part of the cost of the work should be charged to the same account as new plant equipment.

As the balance sheet is becoming more and more the guide of management, it is important that the figures therein should be absolutely accurate, and that all items should be charged to the proper account. In these days of competition in the machinery industry, a correct relation between manufacturing costs and selling prices cannot be maintained unless the cost figures are accurate.

* * *

MACHINES FOR ARC WELDING

Until recently arc welding has been largely a hand process, and much welding is still being done by hand that might be done better by machines. Arc welded machine frames, for example, probably would be more generally used if machines were developed for doing this work automatically.

A number of automatic machines are available for simple cutting and welding operations, but as the arc welding process comes into more general use there will be an increasing demand for machines adapted to weld complete machine frames of different types. These machines will be developed to the best advantage through close cooperation between welding machine builders and users. Such cooperation is all the more necessary because it is not only the machine used for the welding that determines the success of the process, but also the design of the machine to be welded. Modifications in design will be necessary to adapt the work to be done by the arc welding process, and it is likely that the next few years will see a great development in machines built to replace hand labor in welding processes.

Looking Through Rose-Colored Glasses

An Analysis of Business Conditions and Prospects and a Plea for an Open-minded Evaluation of the Future

By ALVAN T. SIMONDS, President, Simonds Saw and Steel Co., Fitchburg, Mass.

IT seems strange that in a country like the United States business as a whole—general business—or the volume of industrial production, does not move upward year after year, along a practically straight line, so that business would be constantly, month after month, improving slightly. If this were the case, everyone engaged in business would be always optimistic. Everyone would know that somewhat better business was ahead.

As a matter of fact, however, business does not move that way. Taking business as a whole in the United States, or industrial production, the movement, decade after decade, is upward at an average rate of about 3 1/2 to 4 1/2 per cent per year; but this upward trend is a wave motion, with peaks at intervals of about three years and depressions about the same distance apart.

In the thirty years before 1914 there were ten of these three-year waves or cycles. Since the war, there have been three, and we are now in the fourth. From what has been said, it can be readily seen that James J. Hill's statement that it does not pay to sell the United States short is correct, so far as business as a whole is concerned, and in this respect everyone should be an optimist.

Alvan T. Simonds, President, Simonds Saw & Steel Co.

It is Easy to Become Either Too Optimistic or Too Pessimistic

It is difficult to estimate the losses that come to the people of the United States through this wave-like motion of industry. Business, for example, finds itself in a depression like that which followed the signing of the armistice. Things looked gloomy at the beginning of 1919. At that time, we did not publish, at the beginning of each new year, hundreds of forecasts like those that came out in January, 1929. The forecasts made at the beginning of the year 1919 were not numerous, but they were gloomy.

It seems to be a characteristic of human beings, perhaps particularly so of business men, that when things are going badly, the general forecast is that they are going to keep on going badly, and *vice versa*. Noah had trouble in getting his passengers, human and animal, to believe that the waters were ever going to subside. This is especially true if things have been going badly for a considerable length of time.

Everyone in the United States was gloomy and pessimistic early in 1919, when business was actually starting on the road toward the greatest boom that this generation has witnessed. The boom was not confined to the United States, but spread practically all over the world. As the movement gathered speed and power through 1919 and early in 1920, everyone was forecasting unheard-of, unbelievable business prosperity for the United States. Salesmen became simply order takers. It was a seller's market. As the bursting point of the unhealthy boom approached, optimism increased. Nothing could stop the tremendous prosperity which had only just begun. It has been stated that only five business men in the United States gave warning that the bubble was about to burst; but burst it did about the middle of 1920. Business turned down into the worst depression that has occurred in the memory of the present generation; 1921 was a year of old-fashioned "hard times."

After the turn from the boom had come and business began to fall off, everyone became pessimistic. Bulls took to cover. The amount of pessimism in the United States increased as business decreased until the pessimism was greatest just as the sun burst through the clouds and business began to turn upward through 1922 to the next peak in 1923. Then everyone became so enthusiastic and optimistic that Secretary Hoover and Secretary Mellon both sent out warnings, and the American

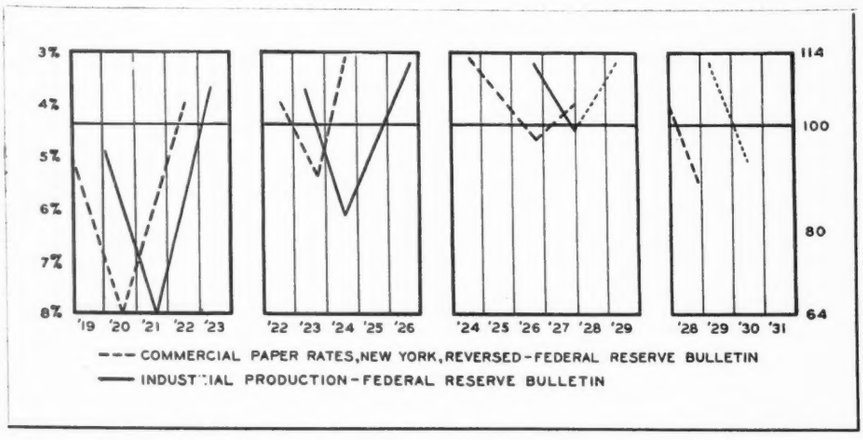
Construction Council recommended that building be postponed for a time, as there was danger that the experience of 1920 and 1921 might be repeated.

Present Tendencies in Business have Inspired Optimism

As we entered upon the year 1929, we were in a somewhat similar situation, especially with respect to the stock market. Those interested in securities and in stocks particularly seemed to believe that prices could advance indefinitely. This idea is based on another belief—that the earning power of industrial corporations can increase indefinitely with greater and greater returns to stockholders, either in regular dividends or in stock dividends. The higher the prices for stocks, the greater, apparently, is the number of those who seem to believe that the prices are too low. Perhaps by the time that this article is published everyone will know better in regard to this matter.

The point I wish to make is that, regularly, just at the turning point of business, people become too optimistic or too pessimistic. When business is moving upward, optimism grows, and either directly or indirectly serves as a means of accelerating the upward turn. I have said advisedly "serves as a means," because I do not want to claim here that either optimism or pessimism is the *cause* of a change in the direction of business. The cause or causes exert their influence earlier. Then crowd psychology hastens the full stop and the movement in the opposite direction.

Business moving toward and near a peak is like an automobile traveling fast. The brake is applied by increasing money rates or some other factors. The car does not immediately come to a stop. The over-optimism of the crowd exerts its influence. The car then stops, sometimes so suddenly that some of the passengers go through the wind-shield. Then the gears are shifted into reverse and the car moves backward. The brake on business, if it is money rates as it usually is, was first applied from ten to twenty months before the advance came to a stop. Thus warning is given of a change in the direction of business many months before the turn actually occurs.



Charts Showing the Cycles of Business Since 1919. The Two High Dotted Lines in the Last Two Diagrams are Estimates of the Trend of Industrial Production in 1928, 1929, and the Early Part of 1930

What are the Present Indications for the Future of Business?

The accompanying chart shows that we had a warning early in 1928 and all through the remainder of that year (note the heavy dotted line). It also shows the warnings given in the three short cycles completed since the war. Notice how the heavy dotted line representing "money-rates reversed" moved before the similar movements of the solid line which represents industrial production.

If the fourth cycle is to develop like the three before it, then the heavy dotted line from January, 1928, to the end of 1928 warns us that soon after the spring rise in 1929, business will turn down in a major swing of a year or longer. The two light dotted lines in the last two diagrams, one running up from the beginning of 1928 to the end of March, 1929, and the other from March, 1929, down to the middle of 1930, are estimates of the trend of industrial production. This does not mean that 1929 will not be a prosperous year, so far as total sales and profits go. It may be, in this respect, like 1926, a very good year, in which business turned down to a recession through 1927. It does not mean that there will not be the usual rise in the spring of 1930; but it means that this rise will not be so high as the rise in the spring of 1929. There is little doubt, I believe, that business leaders expect such a recession, and that conditions in 1930 will be very similar to those that existed in 1927. And yet they forget to mention it in their optimistic forecasts for 1929.

Let Us Be Open-minded in Our Efforts to Evaluate the Future

Are we right in believing that, in the sum total, business will gain if we can make everyone believe that things are going to keep on improving, when we know a decline is threatened? Will misrepresentation and ignorance instead of knowledge and truth increase the success of business managers? Is it not time for us to give up the silly belief that business is afraid of the dark, and begin to give warning of cold and storms in business, as we do in weather?

To prepare for booming business when a recession or a depression is before us, means greater losses than would be incurred by preparing for a falling off, only to be surprised by a rise. The history of the boom of 1920 and the depression of 1921 is clear upon this point. The over-ordering and over-extension of 1920, due to unintelligent over-optimism, caused the tremendous losses and hard times of 1921.

It is very important to recognize that we cannot fill up a business valley or depression after we have passed through it. As President Hoover tells us, the only way we can fill up a business valley or

depression is to take the filling off the peak which always comes just before the valley. We cannot take this filling off the peak on the other side of the valley, for business does not retrace its steps. It travels the road only once.

It is evident that we shall not take off the peak to fill the valley ahead of us unless we know the valley is there. As we collect more data and better understand the movements of business, we are able to see ahead more clearly. Let us use our influence to take the rose-colored glasses off the eyes of those who are afraid of reality, and to put the truth on the lips of those who know, but who believe that knowledge is dangerous for all others but themselves.

* * *

ENGINEERING FELLOWSHIPS

The University of Wisconsin announces that the following fellowships in engineering are available for the year 1929-1930: Three university fellowships available to graduates of engineering colleges of recognized standing, with stipend of $750 a year; two research fellowships for a period of two years; salary for the first year $900, second year, $1100. Candidates must be graduates of engineering colleges of recognized standing and should have had one or two years of graduate study, teaching, or engineering experience. Appointees are expected to devote not less than one-half their time to assigned research. Appointments will be made April 25, and applications should be received not later than April 15.

Application blanks may be obtained from Dean F. E. Turneaure, College of Mechanics and Engineering, University of Wisconsin, Madison, Wis., or from Dean C. S. Slichter, of the Graduate School, University of Wisconsin.

Announcement is also made by the Ohio State University that several fellowships for graduate study in engineering are available to holders of bachelor's and master's degrees. A stipend of $750 for the school year is allowed. Details and application blanks may be obtained from the Dean of the Graduate School, Ohio State University, Columbus, Ohio, or from the Director of the Engineering Experiment Station, Ohio State University.

* * *

What is believed to be the longest train having the greatest number of cars ever operated over any railroad with one locomotive was recently run west out of Victoria, Va., on the Virginian Railroad. This train was 8482 feet long—more than a mile and a half. It consisted of 189 empty coal cars and 12 other cars—201 cars in all. The locomotive used was a 2-10-10-2 Mallet, such as is used for regularly handling loads on this railroad of 14,000 tons, averaging from 125 to 160 cars.

Developments in Airplane Design

There is no engineering development that holds the attention and fires the imagination of both the engineer and the layman to a greater extent than that of transportation through the air. The leading article in May MACHINERY will deal with the latest developments in airplane design in a concise manner, showing a great many of the latest types of airplanes and describing briefly the materials that are used in airplane construction and special detail design features of the latest planes. This article is written with a view to interesting men engaged in any class of mechanical work, and details that are of interest only to airplane engineers have not been included. Instead, the article presents a concise review of the present state of the art for the general engineering reader.

TRENDS IN EUROPEAN CAR DESIGN

European automobiles that are having the largest sales fall into three main types—the "baby" four-cylinder car of 7 to 9 horsepower (Royal Automobile Club rating)—the "family" four-cylinder car of 12 to 14 horsepower, and the light six-cylinder car of 15 to 20 horsepower—according to Maurice Platt, an English engineer, writing in the *S.A.E. Journal*.

The diminutive "baby" cars owe their popularity to low cost of purchase, tax and upkeep, the facility with which they can be driven and parked in towns, and to ease of maintenance, since the European car owner does a great deal of maintenance work himself. These cars usually accommodate four persons and are extremely durable in hard service. The cylinders are of about 2 1/5 inches bore and 3 inches stroke. An orthodox three-speed transmission is provided. The price ranges from $660 to $975.

The family-type four-cylinder car, which is bought in great numbers by men with incomes of about $2500 a year, sells for $975 to $1220 in the closed model, although there are many that are priced higher because of distinctive appearance and better quality.

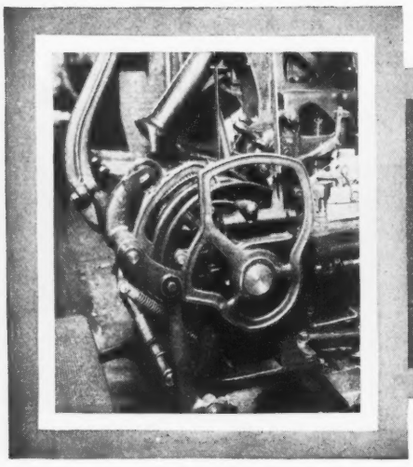
Quantity production of light six-cylinder models is a comparatively recent development in Europe, but almost all leading makers are turning them out. In many cases the same chassis is used for both a 14-horsepower four-cylinder model and a 16-horsepower light six. The usual run of prices is $1460 to $2685. There are also many entirely new designs in this class, and opinion is fairly equally divided between the desirability of providing three-speed or four-speed transmissions.

In addition to the foregoing classes, there are several other types, of which the sports car is the more numerous. And there are many large and expensive cars also, ranging in size up to the twelve-cylinder model and in price up to approximately $12,000.

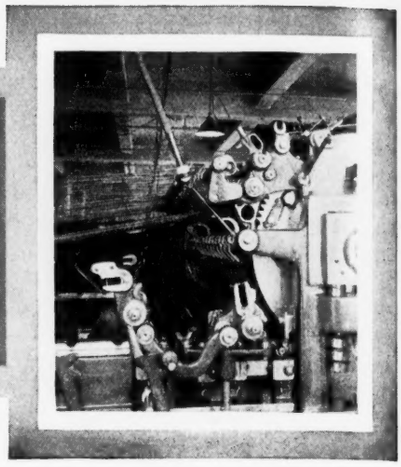
* * *

READING AND EDUCATION

Once a man's reading has progressed to the point where one book leads to another and one subject suggests another, his real self-directed education has begun. Begin with those subjects that have a close relation to your present purpose in life, and follow with the subjects that branch out from this. Do not scatter! The great difference between being educated and uneducated does not always consist in the amount of reading and study accomplished, but in the amount of *intelligent, well-directed* reading and study that is done. The education we get when working for a purpose is most apt to be of value.—F. R. Robinson in the *American Magazine*.



Ingenious Mechanical Movements



OVERLOAD RELEASE MECHANISM

By WINSTON S. PIERCE, Jr.

The valve driving mechanism of a certain rotary valve type of gasoline engine is provided with an automatic release mechanism as a safeguard in case the rotors should seize, due to a failure of the oil or water supply. The crankshaft transmits motion to hollow shaft *A* through a pair of bevel gears, and this motion is transmitted through pin *B*, sleeve *C*, and pin *D* to shaft *E*, which turns the rotors through another pair of bevel gears. Hollow shaft *A* fits over an extension on shaft *E*, and is held against endwise movement by a thrust collar.

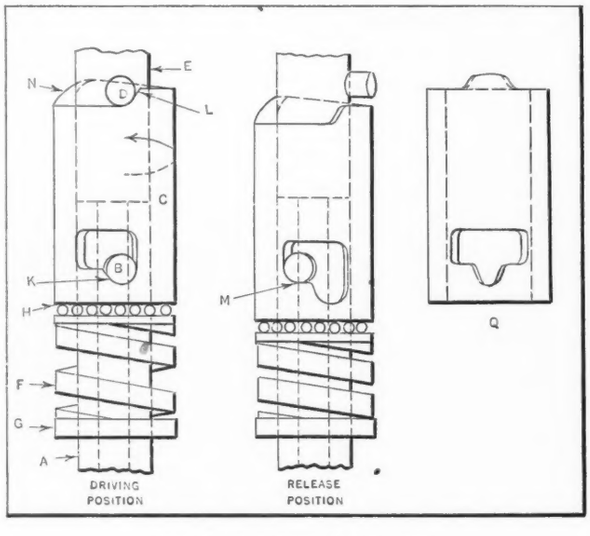
Pin *B* engages a slot in sleeve *C*, this slot being similar in form to the well-known bayonet lock. Pin *D* in shaft *E* engages a cam surface formed on the end of sleeve *C*. The sleeve is held firmly against pin *D* by spring *F*, the tension of which may be adjusted by changing the position of collar *G*. A ball thrust bearing *H* is located between the spring and sleeve *C*.

Normally, the entire assembly rotates in the direction indicated by the arrow, and it will be evident that sleeve *C* tends to slide downward, as pin *B* bears against an inclined surface *K* and pin *D* bears against an inclined surface *L*. Ordinarily, however, sleeve *C* is prevented from sliding downward by the upward pressure of spring *F*.

If the torque reaches the danger point, the spring thrust is overcome and sleeve *C* moves downward far enough to release pin *D*, which moves along a slight rise and finally disengages pin *B* from slope *K*, thus allowing the level surface *M* to engage pin *B*, which now rests against the end of the slot. Pin *B* holds sleeve *C* in this released position, and rotation of *A* and *C* continues while shaft *E* remains stationary.

To re-engage the drive, the crankshaft is given a few backward turns. As shaft *A* revolves sleeve *C*, due to the upward pressure on pin *B* and the frictional resistance between *B* and *C*, surface *N* comes into contact with pin *D*. At this point, any further turning movement would force sleeve *C* downward. However, the resistance between pin *B* and surface *M* is slight in comparison with the force required to rotate surface *N* beneath pin *D*. Therefore, shaft *A* and pin *B* turn until the pin engages the lower part of this slot and is again in the driving position. The clicking sound made by the dropping of pin *B* shows that it is unnecessary to continue turning the crankshaft backward, although more turns than required will do no harm, because each succeeding revolution simply results in forcing the sleeve downward as surface *N* engages pin *D*, the sleeve snapping upward into place again when pin *D* passes surface *L*.

This mechanism automatically retimes the rotary valves as well as the ignition, because the various parts always occupy the same relative positions when the forward drive begins. The special sleeve shown at *Q* is intended to provide the automatic release, regardless of the direction of rotation. While this design *Q* is not actually being used, it doubtless would be satisfactory, as the principle of operation is the same. The cam surfaces are altered to provide release in either direction of rotation and to permit re-engagement by turning backward relative to the direction for driving.



Overload Release Mechanism

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OSCILLATING MECHANISM

By P. A. UDALL

The intermittent reversing mechanism shown in Fig. 1 is an important part of a power-driven valve-grinding machine designed for automatically grinding-in any desired number of valves at one time. At *A*, Fig. 3, is shown a cylinder head with its valve *B* in position for grinding. The grinding movements imparted to the valve consist of rotating the valve

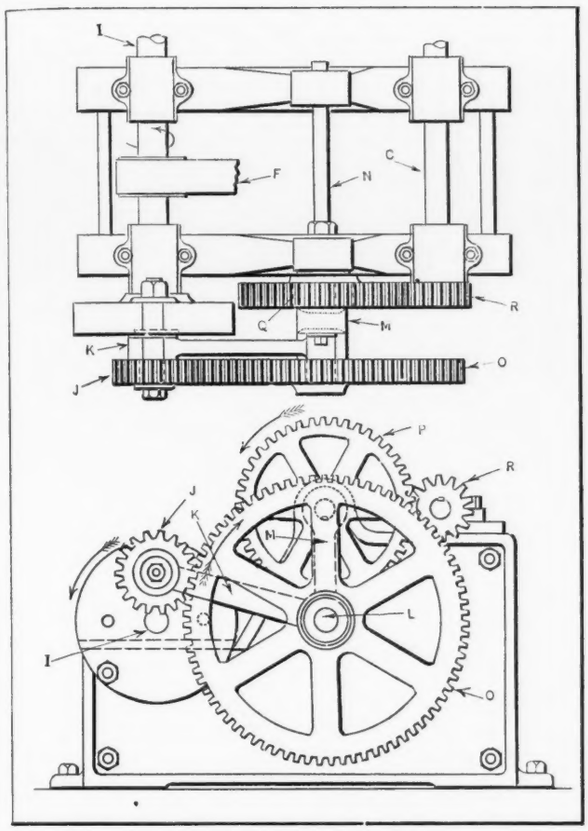

Fig. 1. Intermittent Reversing Mechanism

approximately two-thirds of a revolution in one direction, then reversing the direction of rotation for one-third of a revolution and so on, the point of reversal being constantly changed, a feature which tends to prevent the cutting of grooves by the abrasive grit.

In addition to the reversing or oscillating movements, the valve is raised intermittently to allow the grinding or abrasive material to flow in between the seat and the valve. The various parts of the mechanism are designated by the same reference letters in the different illustrations.

Although this article deals primarily with the intermittent reversing mechanism shown in Fig. 1, brief reference to its application as indicated in Fig. 3, will perhaps make the operation of the mechanism more readily understood. The shaft *C* of the reversing mechanism imparts the oscillating movements to the valve-grinding spindle *S* through bevel gears *D*.

The shaft *E*, driven by belt *F* from the reversing mechanism, is equipped with cams such as shown at *G* which transmit the intermittent valve-lifting movements to studs in contact with the valve stems, one of which is shown at *H*. Although only one valve-grinding spindle is shown in the assembly view, Fig. 3, a large number of similar spindles located at convenient intervals along the bench are driven by shaft *C*.

Construction of Intermittent Reversing Mechanism

Referring to Fig. 1, shaft *I* is connected with the lineshaft by a direct belt drive and is revolved continuously in the direction indicated by the arrow. Keyed to one end of shaft *I* is a disk having a small gear *J* secured to it in an off-center position with respect to the shaft.

The connecting-rod or link *K* has a bearing on the solid stub shaft of gear *J* at one end, and a bearing on the shaft *L* at the other end. Shaft *L* is journalled on an oscillating arm or pendulum *M*, the upper end of which pivots on shaft *N*. The gear *O* keyed to shaft *L* is thus kept in mesh with gear *J* at all times and has an oscillating movement similar to the pendulum of a clock, which results from the movement given shaft *L* by connecting-rod *K*.

In addition to the oscillating movement, gear *O*, with its shaft *L*, is rotated slowly by the driving gear or pinion *J*, one revolution of shaft *I* being equivalent to one revolution of gear *J* under the usual operating conditions. Keyed to the rear end of shaft *L* immediately back of the oscillating arm *M*, is a pinion *Q* (see Fig. 2) which meshes with a gear *P* journalled on shaft *N* on which arm *M* is pivoted.

It is obvious that the slow drive transmitted to gear *O* by gear *J* will also be transmitted to gear *P*. In addition to this drive, gear *P* is also revolved by the oscillating movement of gear *Q* keyed to shaft *L*, being revolved first in one direction and then in the other. The design of the gearing is so calculated that when the connecting-rod *K* moves forward, gear *P* will also be revolved forward; that is, when the connecting-rod *K* moves from the position shown by the full lines in Fig. 2, to its extreme position to the right, there will be added to the slow driving movement of pinion *J*, through gears *O* and *Q*, the driving action of the pendulum or

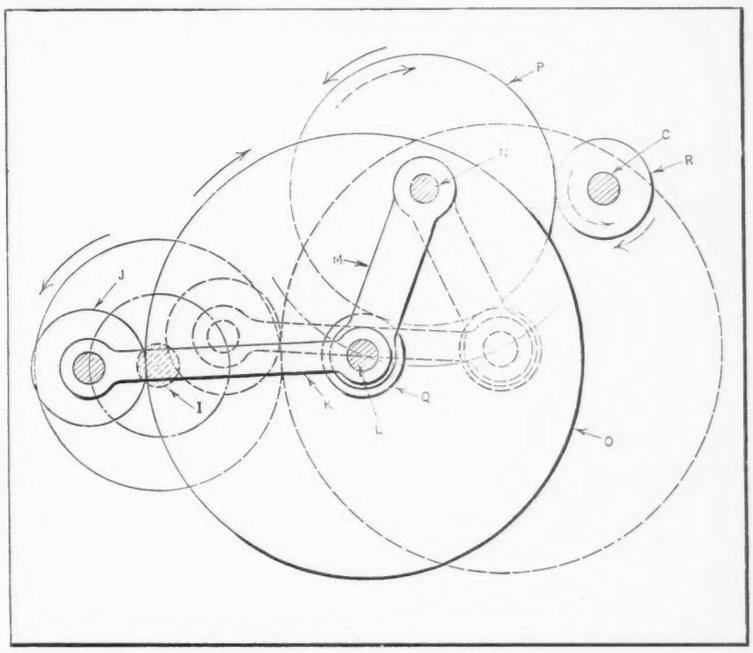

Fig. 2. Diagram of Mechanism Fig. 1, Showing Parts at Beginning of Forward Driving Movement in Full Lines and at Beginning of Reverse Movement in Dotted Lines

swinging movement also transmitted by the teeth of gear *Q*. Thus, gear *P* is driven forward in the direction indicated by the full line arrow until the connecting-rod starts its backward movement at approximately the position shown by the dotted lines in Fig. 2.

On the back stroke of rod *K*, gear *P* will be revolved in the opposite direction, as the driving speed in the reverse direction, resulting from the oscillating movement, is much greater than the slow forward driving movement of the pinion *J*. Thus, the driven gear *R* on shaft *C* is revolved first in one direction and then the other, the gear ratios being so calculated that the valve-driving spindles *S*, Fig. 3, will revolve approximately two-thirds of a revolution in the forward direction, then in the reverse direction for one-third of a revolution, but never reversing in the same position due to the constant flow forward drive of gear *J*.

The reversing mechanism is always the center of interest for visitors to the plant, who are attracted by the peculiar action of the oscillating gear movements which can be adapted for purposes other than that described. The complete valve-grinding machine is the patented invention of the writer and was designed by him for a large concern engaged in the manufacture of tractors.

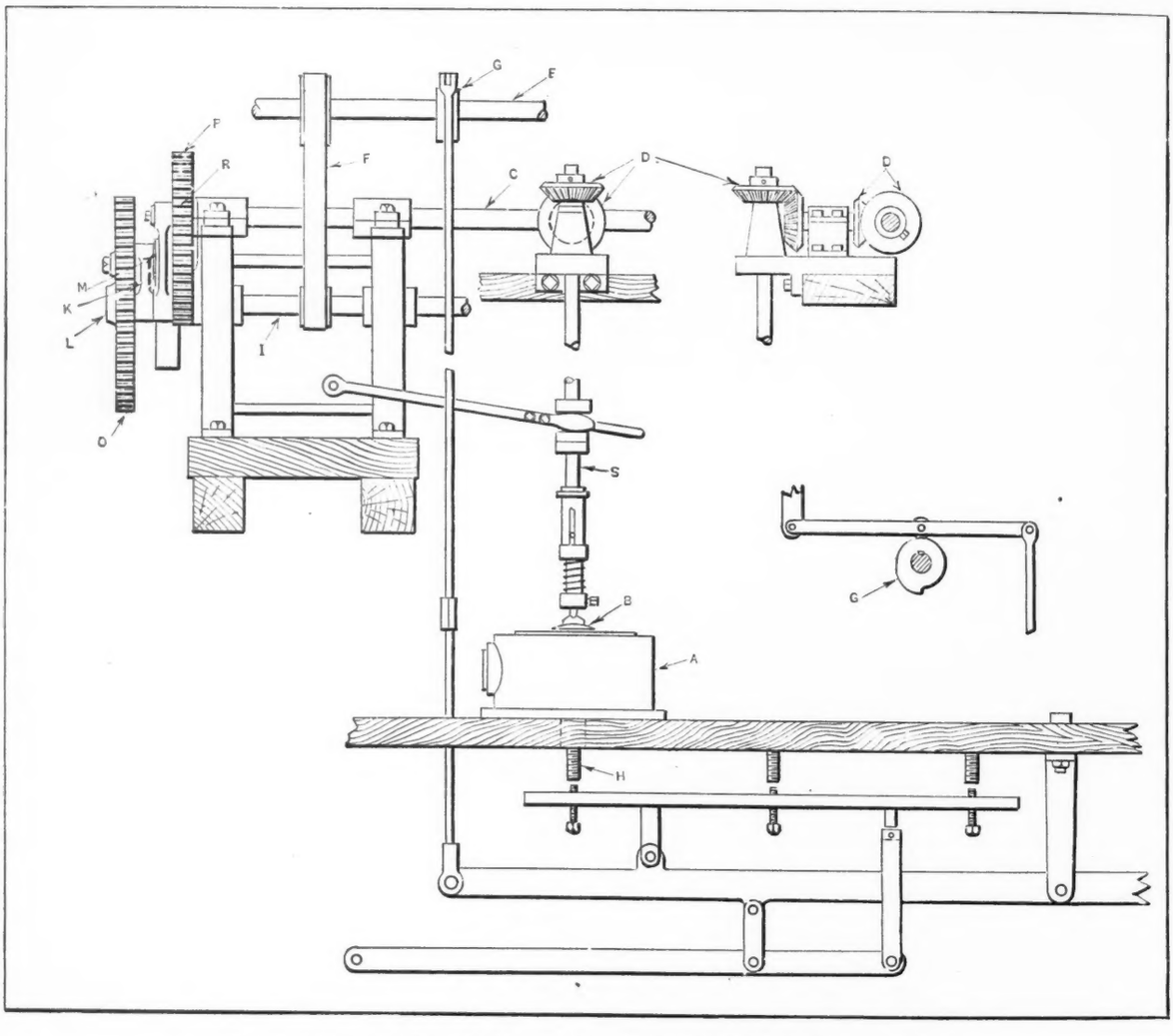

Fig. 3. Valve-grinding Machine Equipped with Mechanism Shown in Fig. 1

MACHINE SHOP MEETING IN CHICAGO

A joint meeting of the American Society of Mechanical Engineers and the Western Society of Engineers was held at the Engineering Building, 205 Wacker Drive, Chicago, Ill., March 18, at which a number of papers were read of unusual interest at the present time in the machine shop field. The subjects and authors of these papers were as follows: "Commercial Status of Carboloy, Its Characteristics, Capabilities and Limitations," by G. N. Sieger and E. G. Gilson of the Carboloy Co., New York; "Cylindrical Grinding," by R. E. W. Harrison of Cincinnati Grinders, Inc.; "Principles Involved in the Design of Products Made of Pressed Metal," by R. I. Miner of the Youngstown Pressed Steel Co.; Discussion on the "Nitriding of Steel from the Point of View of Its Practical Application," By H. W. M'Quaid of the Timken Detroit Axle Co.; "Testing and Testing Methods Featuring the Magnetic Method of Detecting Flaws in Steel and Determining Physical Properties," by A. V. de Forest of the American Chain Co. There were afternoon and evening meetings. Harold Greenhill of William P. Greenhill & Sons, Chicago, presided at the former, and Frank W. Curtis, western editor of the *American Machinist*, presided at the latter.

Piercing, Cutting-off and Bending Die

An Unusual Die in which the Forming or Bending is Done in the Last Stage Because of the Design of the Work

By R. H. KASPER

THE most interesting point in the design of the die shown in Fig. 1 is that it pierces and cuts off the piece *W* from the strip stock, as shown at *Y*, before forming or bending. The forming is done in the last stage because the spade-shaped ends cannot be cut to the required outline without completely severing the pierced part from the strip stock.

As the piercing punches are of conventional design, they will not be described. When the die is in operation, the stock is fed in from the left side and is pierced by the punches *A*, *B*, *C*, and *D*, being located in its proper position at the second stage by the pilot *E*. Plan views of the punch and die are shown in Figs. 2 and 3, respectively. Punch *F*, Fig. 1, separates the flat blank from the strip at the third position or stage. The flat blank is then formed into a hairpin bend by the forming punch *G*, which forces it into the groove in block *H* on the descent of the press ram.

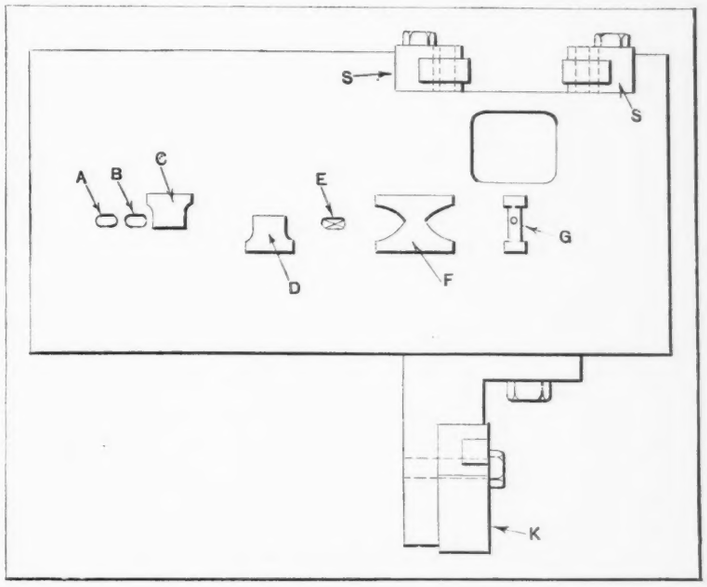

Fig. 2. Plan View of Punch Shown in Fig. 1

Punch *G* is provided with ribs which increase its rigidity. A small prick-punch is located in the center of the forming end of punch *G*. This punch is set so that it strikes the stock ahead of the cut-off punch *F*, and thus serves to keep the blank from moving after it has been cut off. It also prevents the stock from drawing unevenly during the bending operation, which is an important factor, owing to the proximity of the two holes to the bend.

In Fig. 1 and in the view at the left in Fig. 4, the ram of the press is shown in its extreme upper position. At this point, the ejector *I* is at its extreme forward position. Ejector *I* is actuated by the cam groove in block *K*, which operates lever *J* through contact with its roller *L*. As the ram descends, the cam groove in block *K* causes ejector *I* to recede to the extreme rear position, as shown in the view at the right, Fig. 4, at which point it remains at rest until the ram has reached about the midpoint of the upward stroke.

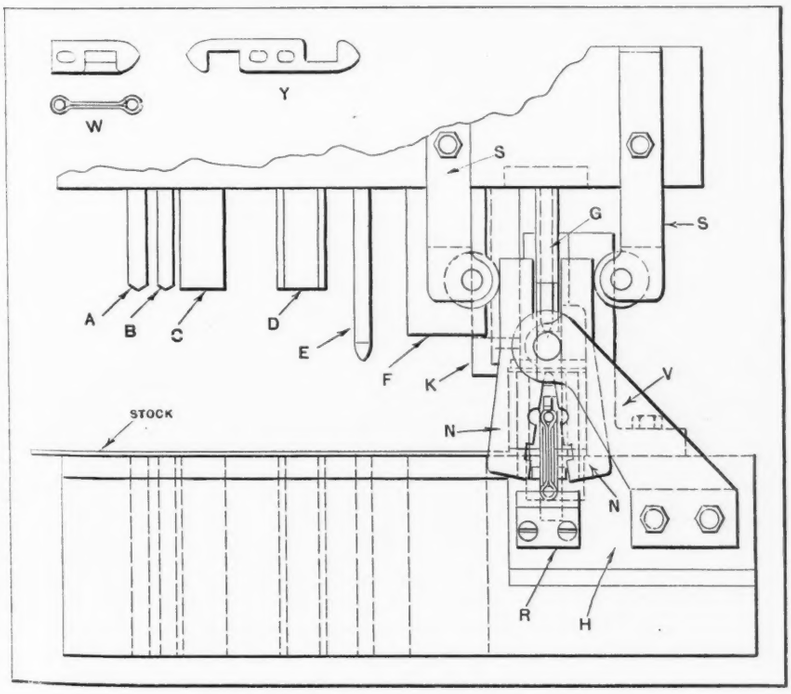

Fig. 1. Follow-die and its Product

As the punch *G* forces the flat blank into the groove in block *H* in making the first bend, it passes between two guides or strippers *M*, Fig. 4, which prevent the formed blank from being lifted with punch *G* on the upward stroke. It will be noted that block *H* is grooved at *T*, Fig. 3, to permit the rear rib of punch *G* to enter, while the front rib has been cut away at the bottom to avoid the necessity of providing another groove in block *H*. This also avoids restriction of the movement of the work when it is pushed forward by the ejector *I*.

On the up stroke of the ram, ejector *I* remains at rest until the roller on lever *J* reaches the angular portion of the cam groove in block *K*, at which time the front

flange on punch *G* entirely clears the work, leaving it free to be moved forward. As the ram continues upward, ejector *I* moves forward, pushing the work ahead of it, through the bridge *O*, until, at the extreme upper end of the stroke, the work is located between the forming jaws in readiness for the final forming.

The final forming is done by the jaws *N*, which press the work around the cylindrical projections on plate *P*, Fig. 4. Guide plates *Q* prevent the work from springing open when it is being entered between jaws *N*, while the piece *R*, Fig. 3, supports the work during the forming operation. The jaws *N* are supported on the bracket *V* and are closed on the down stroke by the rollers carried on the arms *S*, Fig. 4, as they pass over the angular surfaces of the jaws. This arrangement insures a positive movement. As the ejector *I* could be made only as thick as the stock, ribs were attached to its outer sides to provide the required stiffness.

Lever *J* is hinged and provided with a spring *Z* so that it will spring backward, rendering the ejector *I* inoperative in case one of the blanks should stick. After the work has received its final forming, it remains in position until the next upward stroke of the ram, when it is moved forward by the following piece of work. In the front view, Fig. 1, and in the end view shown at the left, Fig. 4, the die is shown with the ram at the top of its upward stroke and with a finished piece in the forming position. In the view at the right, Fig. 4, the die is shown with the ram at its lower position. As the ram ascends, the piece, which has received its initial bend, will be pushed forward by the ejector *I*, replacing the piece which has just received its final forming operation. The die described is used on a single action punch press which operates at a speed of 160 strokes per minute.

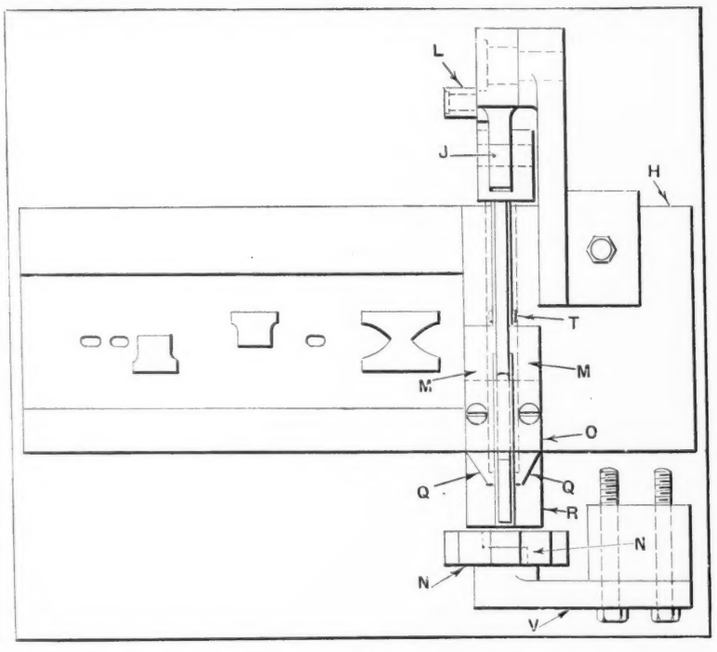

Fig. 3. Plan View of Die Shown in Fig. 1

* * *

NEW ALLOYS AT CHEMICAL EXPOSITION

At the twelfth exhibition of the Chemical Industries, which will be held at the Grand Central Palace, New York City, May 6 to 11, the exhibits of fifteen steel and metal manufacturers will indicate the advances made in various alloy steels. For the first time there will be exhibited a new acid-resisting alloy developed by the Krupp Company in Germany. This metal is said to have many unusual features that will prove of interest in the mechanical field. Numerous instruments of precision, valuable in the mechanical as well as in the chemical field, will also be on exhibit.

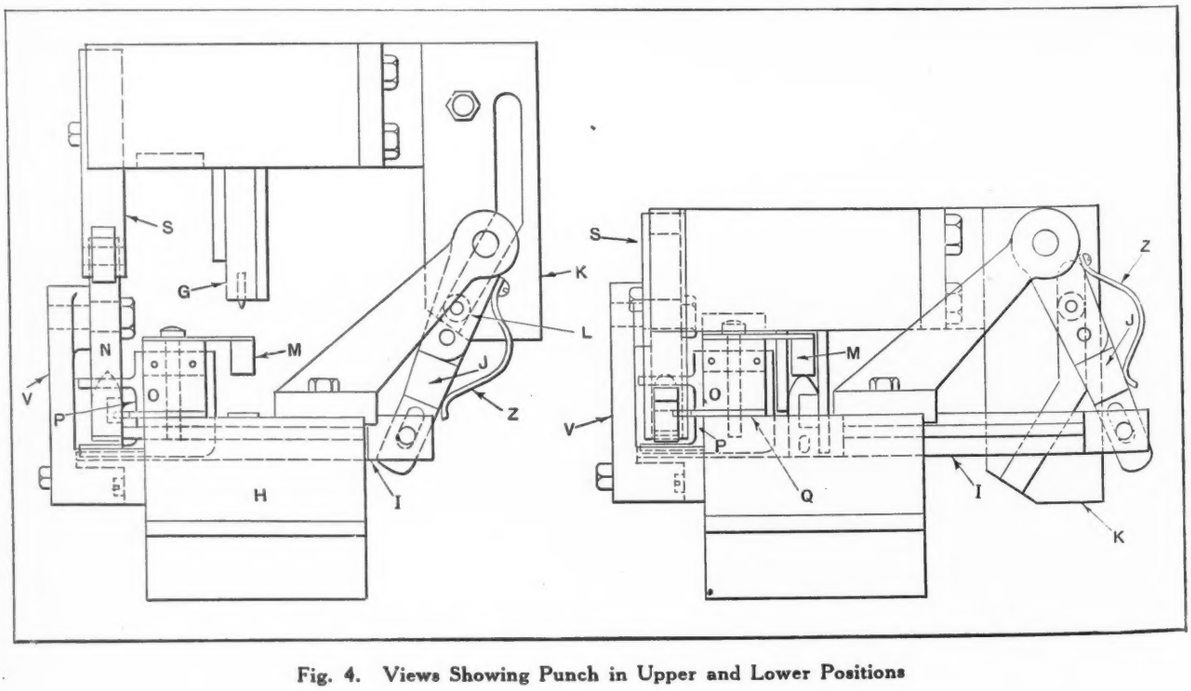

Fig. 4. Views Showing Punch in Upper and Lower Positions

Production Equipment for Connecting Yokes

Fixtures for Gang-milling, Broaching, and Drilling Connecting Yokes on a Quantity Production Basis

By F. H. MAYOH

A CAST-IRON connecting yoke, which in itself is not a difficult piece to machine, but which presents interesting tooling problems when it is to be manufactured in quantities, is shown in Fig. 1. The finish marks indicate the surfaces to be machined. The special jigs and fixtures designed to permit the surfaces to be machined complete in four handlings of the work are shown in the accompanying illustrations.

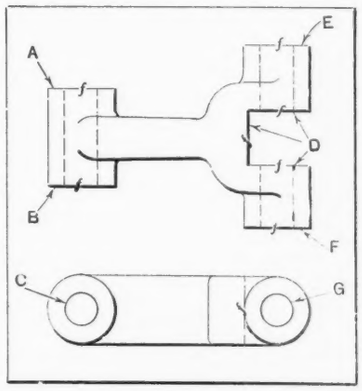

Fig. 1. Cast-iron Connecting Yoke

The first operation consists of machining the ends of the bosses at *A* and *B*. This is followed by drilling and reaming the hole *C*, after which a draw-broaching operation finishes the three surfaces *D* and the ends *E* and *F*. Following this, the part is placed in a drill jig and the holes *G* are drilled and reamed.

Gang-milling the Boss Ends

In Fig. 2 is shown a milling fixture of the gang type arranged for milling the ends *A* and *B*, Fig. 1. Advantage is taken of the bosses at the opposite end of the work for locating purposes. The method of setting the work *H*, which is shown by heavy dot-and-dash lines, is quite clearly indicated by the end and side views, Fig. 2. The cutters *A* and *B*, which machine the ends of the boss, are mounted on an arbor *C* in the usual manner and revolve, while the fixture containing the work travels longitudinally in the direction of the arrow *D*.

The fixture has a cast-iron base *E*, with a steel block *F* screwed and doweled in place. At both ends of the fixture are angle flanges *G*, between which the work is held by a group of wedging devices, which hold or clamp the pieces so securely that they can be milled as readily as one continuous or solid piece. Ten connecting yokes *H* are held in this fixture. The yokes rest against a solid block of the type shown at *J* at the ends of the fixture and against a block *K* in the intermediate positions. The blocks *J* are secured to the flanges *G* by screws, and the intermediate blocks *K* fit into grooves in the back wall of the casting *L*.

There are five wedge-shaped clamping members *M*, which, when tightened down by the nuts on

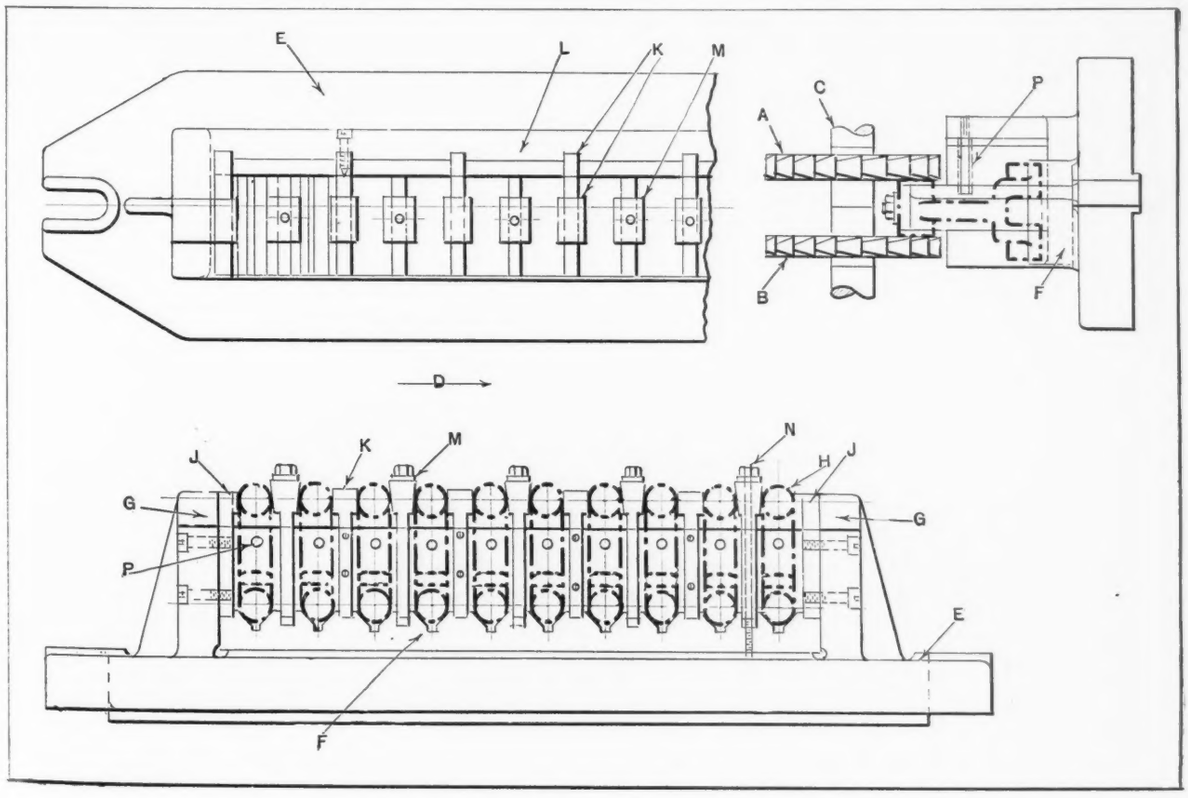

Fig. 2. Gang Milling Fixture Used in Finishing Surfaces A and B, Fig. 1

screws *N*, securely wedge the work between the stationary members *K*. The work is located in the V-grooves of the block *F* and against a series of pins *P*. This clamping method secures the work rigidly in place, so that it effectively resists the thrust of the milling cutters as they mill the boss ends on the connecting yokes. The clamping members *M* are free to float sidewise, so as to adapt themselves to irregularities in the castings.

Drilling and Reaming the Bosses

Following the gang-milling operation, the yokes are placed in the drill jig shown in Fig. 3, which has a hardened steel bushing *B* pressed into the cast-iron base. One of the surfaces just finished rests on this bushing, while the threaded bushing *D*

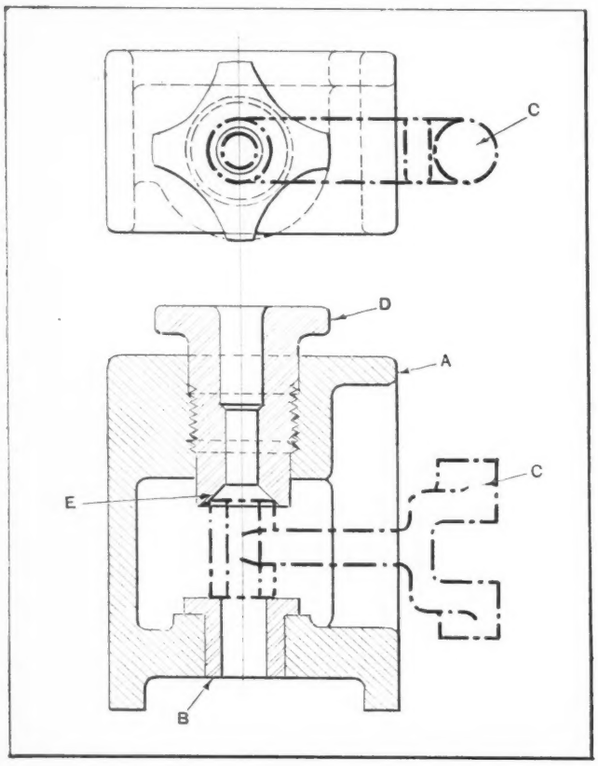

Fig. 3. Jig for Drilling Hole C, Fig. 1

is tightened over the opposite end of the boss to clamp the work down against the bushing *B* and at the same time center the boss in the chamfered hole *E*. Bushing *D* is made with a knob at its upper end, so that it can be tightened by hand.

The operator first spots the boss with a short drill which fits the small hole in the screw bushing, after which he drills through the work with a long drill and then reams the hole to size. This operation completes the finishing of the single boss, which now has an accurate hole in proper alignment with the bosses at the yoke end. The unusual set-up illustrated in Fig. 5 shows how the surfaces *D*, Fig. 1, of the cut-out and the two ends of the bosses are finished by one pass of a group of three broaches, using the hole in the short boss for locating purposes.

Broaching Five Surfaces Simultaneously

In Fig. 5, the work *A* is indicated by heavy dot-and-dash lines in a fixture *B* used on a broaching machine. This fixture has a pair of bosses *C* and *D* between which the work is placed. A pin *E* is pushed through the bosses on the fixture and through the hole in the work. The work is then held back against a pin *F* in the fixture, which takes the cutting thrust.

The broach *G* does the cutting in the center groove, while the broaches *J* and *K* finish the boss ends. The broaches, at the time of placing the work in position, are in their extreme right-hand positions at the starting point. They are drawn in the direction of the arrow *H* for cutting, being pulled by a holder of the type shown in Fig. 6.

The draw-bar of the broaching machine is attached to the broach-holder, and the fixture shown in Fig. 5 is centered in the end plate of the broach-

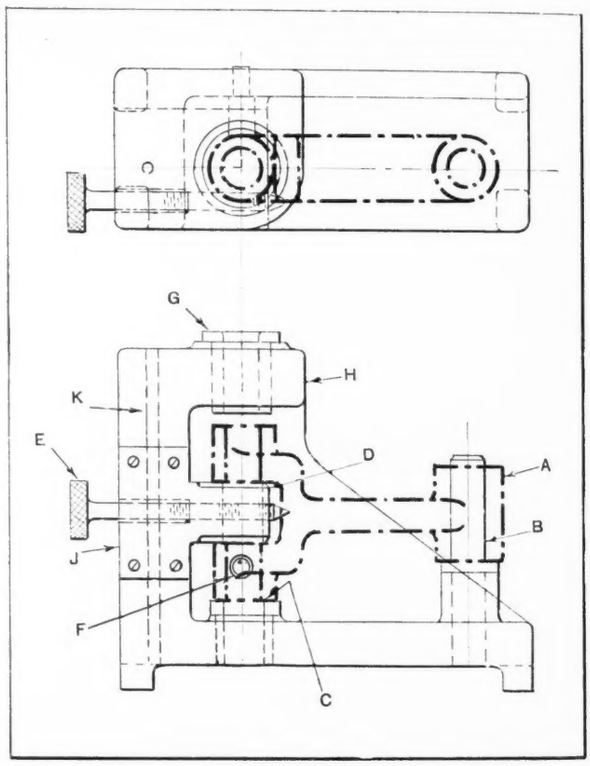

Fig. 4. Jig Used in Drilling and Reaming Yoke

ing machine, where it is held in place by screws. When the operator starts the machine, the broaches are drawn through the work. At the completion of the cutting stroke, the machine is reversed, and the broaches travel in the opposite direction until the holder is close to the inside of that part of the machine that holds the work fixture.

The reduced portion of the broaches near the end secured in the holder is small enough to permit the rough surfaces of the work to clear the broaches at this point, thus allowing the work to pivot on the pin or arbor *E*, Fig. 5, so that it can be swung into place against the thrust pin *F*. The operator then starts the machine, holding the work against the pin *F* until the broaches start to cut. The broaches force the work against the pin while the slots on the ends of the bosses are being broached.

The fixture that holds the work is slotted, so that the broaches can pass through, and the broaches are so made that the sides and back surface oppo-

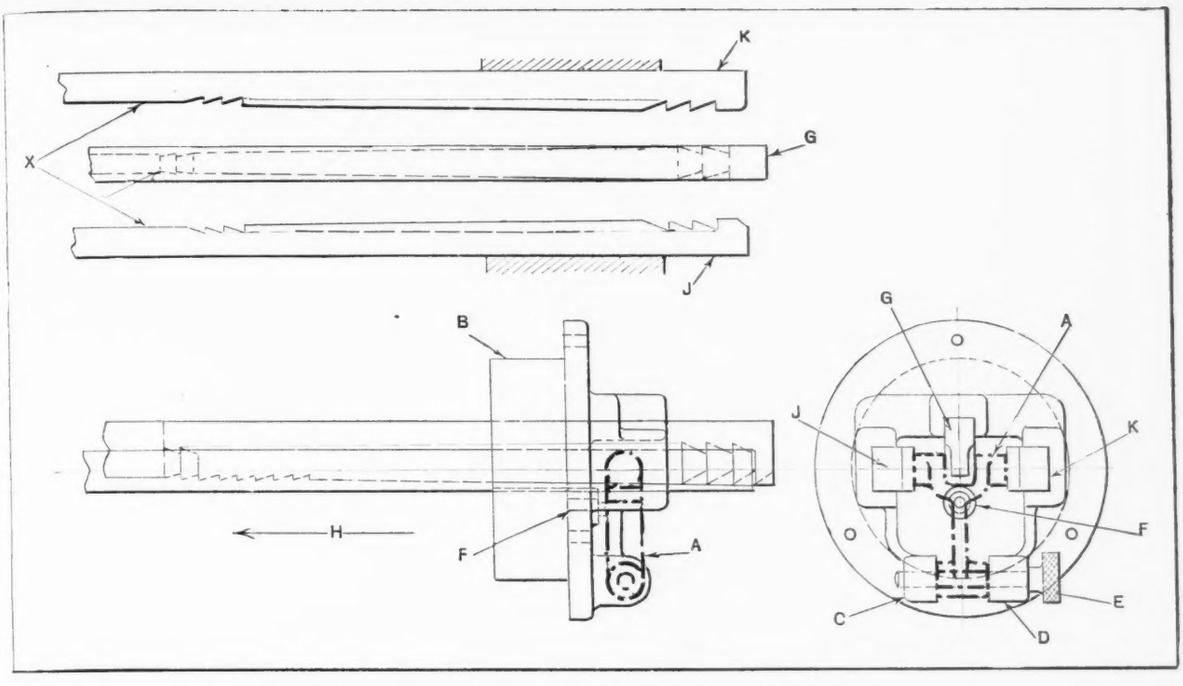

Fig. 5. Broaching Fixture Employed in Finishing Surfaces D, Fig. 1

site the cutting teeth fit these grooves. This construction serves to guide the broaches and prevent sidewise movement, and at the same time backs them up against the thrust resulting from the cutting action. The broaches are so designed that at least two teeth in each are engaged in cutting at the same time, and the teeth are so stepped that each succeeding tooth removes a little more metal than the preceding one.

Referring to Fig. 5, the teeth at *X* just clear the work. From this point to the opposite ends, the teeth gradually increase in height. The broach that finishes the center slot starts to cut ahead of the side or facing broaches. It will be noted in the case of the broaching operation described, that it is unnecessary to disconnect the broaches from their holders after each operation, as is the case when broaching holes.

The final operation consists of drilling and reaming the bosses at the yoke end. For this operation, the work is held in the fixture shown in Fig. 4. This jig is designed to make use of the finished surfaces for locating purposes. The work *A* is placed over a pin *B*, after which it is swung into the position shown by the heavy dot-and-dash lines, where it rests on top of a bushing *C* and a block *D*. The knurled screw *E*, having a tapered end, is tightened against the surface at the bottom of the slot, so that it pushes the work back against a stop-pin *F*. The holes are produced by spotting, drilling, and reaming. Guide bushings, such as shown at *G*, are employed for the drills and reamer.

* * *

An interesting new type of group insurance has been placed by the Miller Mfg. Co., Bainbridge, Ga., builders of machinery. This insurance provides for health and non-occupational accident protection for the employes of the plant. The company already carries regular group life insurance in favor of its employes. Under the new policies payments of from $7 to $12.50 a week will be made to any employe who is unable to work due to sickness or to injury received while not engaged in his work.

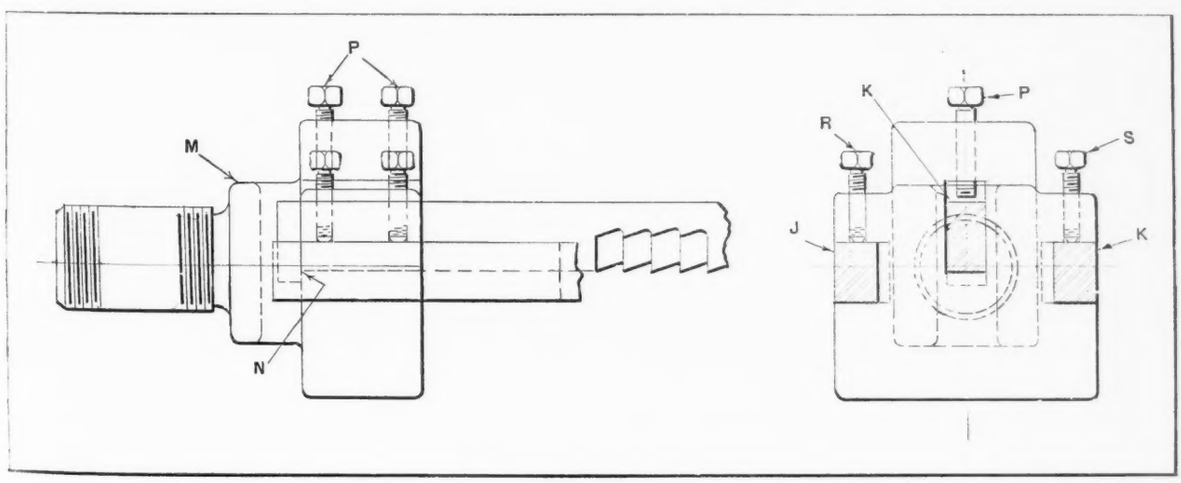

Fig. 6. Holder for Broaches Used in Finishing Surfaces D, Fig. 1

Why Use Rolled Steel for Machine Bases?

An Outline of the Advantages that Are Claimed for the Use of Welded Structural Steel Frames and Bases for Machinery of Different Types

By A. F. DAVIS, Vice-president, Lincoln Electric Co., Cleveland, Ohio

FOR many years machine bases of cast iron and cast steel have been considered ideal. Until the advent of arc welding, casting was the only feasible method of producing them. Today, however, the electric arc welding process has made it possible for manufacturers to utilize the inherent strength of rolled steel in machine bases.

The tensile strength of rolled steel is four or five times as great as that of gray iron castings. The stiffness—the Young's modulus—is very much greater for rolled steel than for cast iron, yet the cost per pound of rolled steel is about one-third the average cost for castings. This means that if a structure is to be built, the utility of which depends solely on the tensile strength of its parts, the cost of the material will be from one-twelfth to one-fifteenth as great if structural steel is used as it would be if castings were used.

Furthermore, the chance of breakage from shock is very much less in a part made up from welded structural steel shapes than in the same part made up from castings. In fact, it is often necessary, in designing cast parts, to increase the cross-sectional area greatly in order to provide adequate resistance to breakage through shock. This accounts to a considerable extent for the much greater weight of castings for a given part, as compared with welded rolled steel.

While the weight of a base made up of welded structural steel parts, and having the same strength as a cast-iron base may be from one-half to one-fifth the weight of a cast base of the same outside dimensions, the saving in cost of the finished base is not always so great as this, because of the cost of the welding and of preparing the structural shapes before they are welded.

The actual saving effected by using arc-welded rolled-steel construction for the bases of various types of machinery is discussed later in this article. Suffice it to say now that the total costs of the new type bases show a saving of from 10 to 70 per cent, as compared with the costs of the cast-iron bases that have been supplanted. This does not mean that all bases for machinery will eventually be made from rolled steel and welded, but it has been conservatively estimated that 75 per cent of the castings used now for bases can be replaced by welded steel structures at a saving in cost. The saving in first cost, however, is not the only advantage of the new type of construction. Other considerations of almost equal importance are:

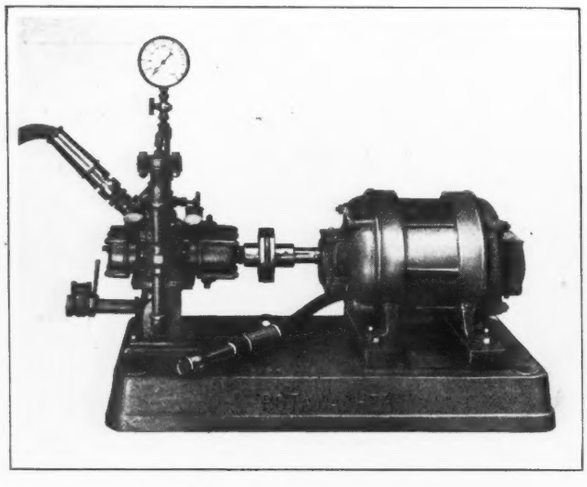

Fig. 1. Pumping Unit Mounted on Cast-iron Base

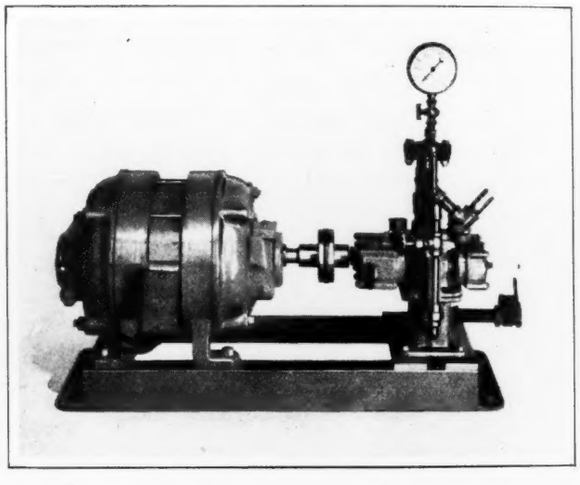

Fig. 2. Same Unit Mounted on Welded Steel Base

1. Less inventory is carried, because the cost of the structural steel for a base is but a fraction of the cost of manufacturing a base by casting, due both to the lower cost of the raw material, and to the fact that the structural steel carried in stock is applicable to various bases, while a separate casting has to be made for each base.

2. The freight cost is less for both incoming and outgoing shipments, since from one-half to one-fifth the amount of material is used for the same results.

3. It is easier to produce special designs, for in making a new base from a casting, complete pattern equipment must be made up. This is expensive and takes a considerable amount of time. Furthermore, patterns are, in many cases, used only once.

4. Very much quicker delivery of a new or specially designed base is possible. It is clear that a manufacturer making his base from welded structural shapes does not have to suffer the delay incident to making drawings for a pattern, making

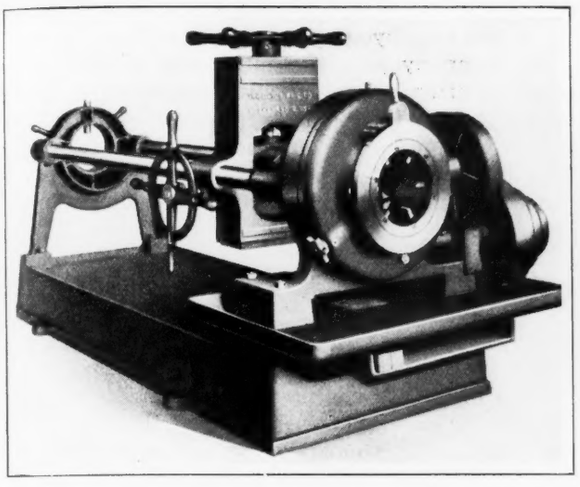

Fig. 3. Pipe Threading Machine with Heavy Cast-iron Base

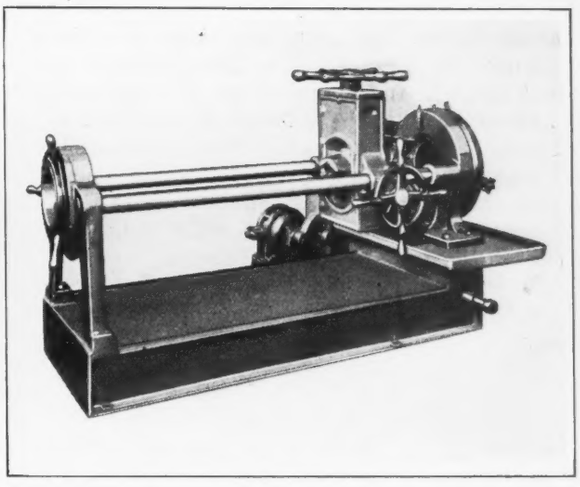

Fig. 4. Machine Shown in Fig. 3 Provided with Base of Welded Steel

the pattern, and making the casting. Therefore, the manufacturer producing a special base from structural steel can make deliveries in from one-half to one-fourth the time required by the manufacturer who uses the casting method.

5. There is no breakage of welded structural steel parts, as often happens in the case of cast bases.

A number of machinery manufacturers have recognized these advantages of arc-welded steel construction for bases. A base of simple design, which was previously cast and is now built up from structural shapes joined by arc welding, is employed on a motor-driven rotary pump for increasing the pressure of water used in washing automobiles. The old style cast-iron base, shown in Fig. 1, cost the manufacturer $12, while the welded steel type, shown in Fig. 2, cost only $4, and weighs a third less than the cast base.

The new type base is lighter, stronger, more rigid, and less costly than the cast base, and it also provides for quieter operation of the pump. When the cast-iron base was bolted down to a concrete floor, its solid top vibrated and acted like a drum, making the operation of the unit noisy. The construction of the new base is very simple. It consists of four angles and two pieces of flat bar stock, arc-welded together. Incidentally, the motor shown in Figs. 1 and 2 is also of welded steel construction.

The base of a large pipe threading machine which handles pipe up to 8 inches in diameter has also been changed recently. The cast-iron base formerly provided for this machine is shown in Fig. 3, and the welded steel base in Fig. 4. Although the new type base appears to be as heavy as the cast base, it is very much lighter and yet much stronger and more rigid.

The top of the main part of the base is merely thin sheet steel, with its edges flanged upward so that they form a drip pan which covers the lateral bracing between the I-section rail members. The same part of the cast base is necessarily much thicker, and therefore adds much to the weight of the base. The pan for catching chips and oil drippings under the head of the machine on the old type base is also a casting. On the welded steel base, this part is of pressed steel and is welded to the base. This construction keeps the weight down to a minimum without sacrificing operating efficiency.

Steel Bases of Complicated Design

A more complicated base of arc-welded steel construction is illustrated in Fig. 5. The cast-iron base which was supplanted is shown in the foreground. These bases are for paper box making machines. The old base was cast in four sections and assembled by bolting. Its weight is 1958 pounds and cost $242, including machining. The newer base is built up from steel channels, angles, and plates, and assembled by arc-welding. The total cost of the new base is $114, no machining being required. It weighs only 520 pounds.

The welded steel bases illustrated in this article are typical of the most common types of machinery bases that can be most advantageously built of welded steel. However, the use of welded structural shapes is not confined to bases for machinery units, but is being successfully applied in the construction of machines of different types and for varied purposes.

While the building of machinery bases from welded structural shapes is a radical departure from the traditional method of building bases,

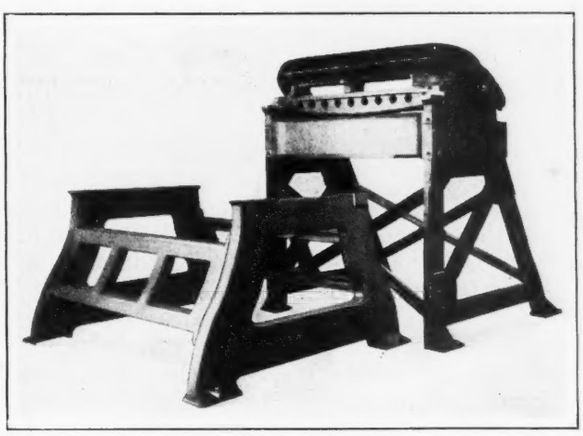

Fig. 5. Cast and Welded Steel Bases for Paper Box Making Machinery

it must be borne in mind that the success of many manufacturers has been due to their ability to recognize the advantages of new methods and to adopt them in the manufacture of their products. It has been said that the secret of successful manufacturing is the proper state of mind. The successful manufacturer is the one who adopts new processes and methods first. He must adopt the point of view that every manufacturing method in his shop can be improved and that his job is to find how a new and better method can be devised to replace the present one; in so doing, he becomes a leader in his field and thereby achieves success.

* * *

HOW ONE FIRM ENCOURAGES INVENTIONS

By H. L. KAUFFMAN

The Union Oil Co. of California has had in effect for almost three years a plan for encouraging employe inventors. This plan has features that may well be adopted by other companies having a vision of what the relationship between employer and employe should be.

The purpose of the plan is to stimulate and assist inventive genius and to provide still another means for unifying and promoting the interests of both the company and the employes. Under the plan the company enters into an agreement with the employe to obtain patents on such useful inventions as the employe might make, and to handle the patents, paying a stipulated award, to the advantage of both.

The employe who makes an invention embracing any device, apparatus, method, process, or improvement relating to the business assigns to the company his entire right in the invention, and, at the expense of the company, assists in every way to obtain a patent.

When the employe conceives an idea, he promptly submits a description of his invention to the management, who then solicits the written opinions of department heads and other interested experts regarding the invention. The company proceeds to file patent applications after the "administrators" (three members of the executive committee) have decided that the invention represents something that would be useful in the business and is patentable. If the administrators reject the idea, the description is returned to the employe with a properly executed release from the agreement—the company keeping only the shop rights to which it is legally entitled.

How the Inventor Shares in the Profits of His Invention

The plan provides that, upon the acceptance of the description and execution of the patent application and assignment, the employe be paid a primary award of $100. If the invention is licensed, additional compensation is received by the employe on the basis of half the net profit so derived. If the patent is sold outright, the employe receives half the net profits resulting from the sale. Additional compensation may be awarded the employe by the administrators, with the approval of the board of directors, if greatly increased profits are enjoyed by the company as a direct result of the use of the employe's invention.

The company pays the entire cost of patenting, which is often an important consideration, more especially so if it becomes necessary to protect the basic invention by improvement patents. Further, if the inventor (filing application as an individual) should encounter difficulties necessitating appeals to the higher tribunals of the Patent Office, or to the courts, or must "fight" interferences with other inventors, who may have filed applications for similar inventions, the cost of patenting may become prohibitive for an inventor of ordinary means.

The Union Oil Co.'s plan with regard to the inventions of its employes is a departure from the traditional policy; most employers assume the attitude that inventions by employes belong to the employer because of special contracts of employment. The Union Oil Co., on the other hand, gives the employe inventor an initial cash reward, and later shares with him in royalties or other profits realized from the invention. The entire idea of suitably awarding employe inventors, as developed by this company, is one that the progressive employer in any industry will find worth while.

* * *

NATIONAL METAL TRADES APPRENTICESHIP DINNER

The sixth annual banquet given by the Milwaukee branch of the National Metal Trades Association for apprentices in their last year and for prize winners in the various trade contests of the year was held on the evening of February 18 in the new dining room of the Milwaukee Vocational School. About 450 executives, officials, and apprentices were in attendance. Harold S. Falk, chairman of the Metal Trades Apprenticeship Committee in Milwaukee, presided. After referring to the progress that has been made in the apprenticeship movement during the past year, he briefly explained the scope and purpose of the trade contests conducted by the association. Awards were then distributed to the winners of these contests. Following the distribution of awards, Robert L. Cooley, director of vocational education in Milwaukee and president of the American Vocational Association, made an address entitled "Oiling the Social Machinery."

* * *

MOTION PICTURE OF HIGH-FREQUENCY FURNACES

An 800-foot reel of motion picture film, showing the melting and pouring of metals, in charges of from one ounce to several hundred pounds, in connection with the use of high-frequency electric furnaces, has been prepared by the Ajax Electrothermic Corporation, Trenton, N. J. The film shows clearly the method of operation of furnaces of this type, and also illustrates the method of applying electricity to the furnace charge. The film is available either in standard or in 16-millimeter widths, and will be furnished to be shown at meetings of engineering clubs and societies upon application to the Ajax Electrothermic Corporation.

Some Methods in the Studebaker Plant

Machining Engine Cylinder Blocks at a Rapid Rate, Testing Engines for Weather Conditions, and Torsion Testing Machine

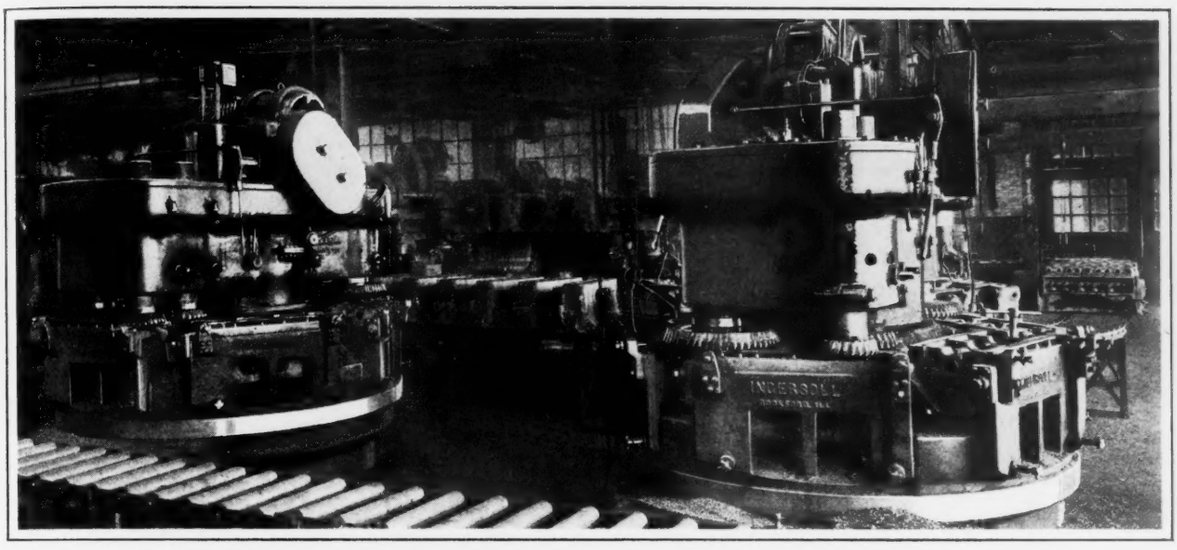

Fig. 1. Rough- and Finish-machining Tops and Bottoms of Engine Cylinder Blocks at the Rate of Thirty an Hour

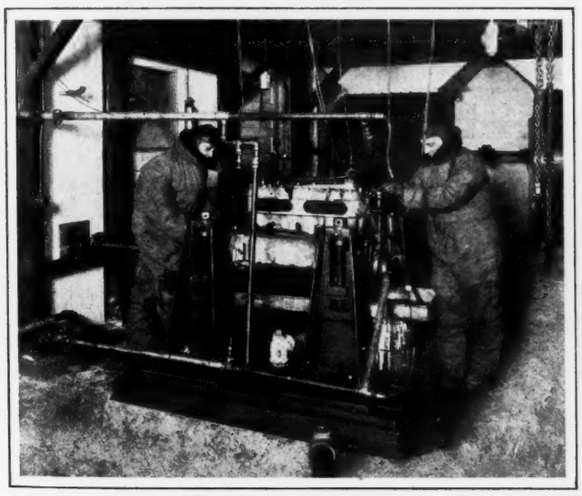

Fig. 2. "Cold Room" where Engines are Tested at Temperatures Corresponding to Varying Weather Conditions

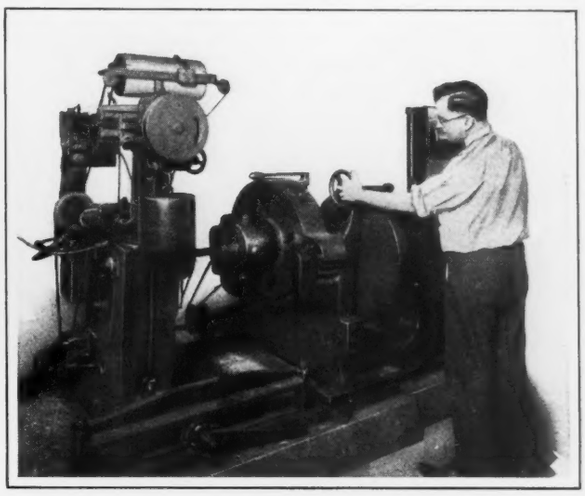

Fig. 3. Torsion Testing Machine with a Rear Axle Shaft being Tested. All Parts are Subjected to Similar Tests

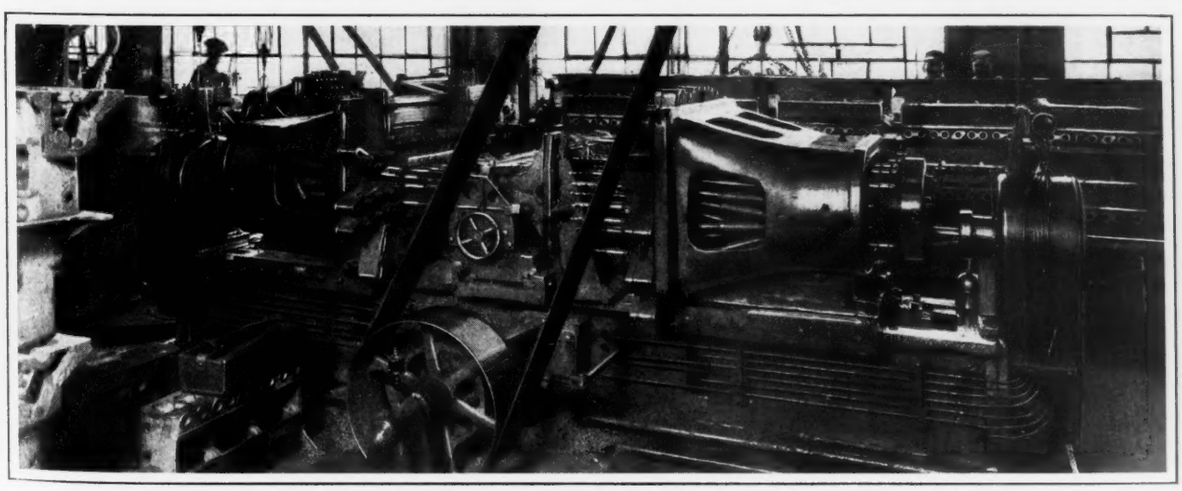

Fig. 4. Drilling the Holes in Cylinder Blocks on a Double-head Machine

Speed and Endurance of Hoist Operators

Results of Tests Conducted to Determine the Speed of Hand-hoist Operators in Lifting Loads and the Normal Hoisting Time Before Resting

By A. M. HARRINGTON, The Harrington Co., Philadelphia, Pa.

INFORMATION available in the past on the subject of hand-hoisting speeds, and the number of men necessary to operate hoists of different capacities, has been so vague as to be very misleading. For this reason, the Harrington Co. has refrained from publishing such data since 1907; but recent demand for reliable information on this subject prompted the company to undertake a series of extensive tests to obtain accurate data.

Previous data on this subject gave only the number of feet per minute at which different full loads could be lifted without causing the operator to exert over 80 pounds of effort, and ignored entirely the fact that the speed is greater for light loads, which require proportionately less pulling effort on the hand chain than heavy loads. Also, the data did not give speeds of hoisting when it was necessary for one man to operate a large-capacity chain hoist requiring a pulling effort that was greater than 80 pounds.

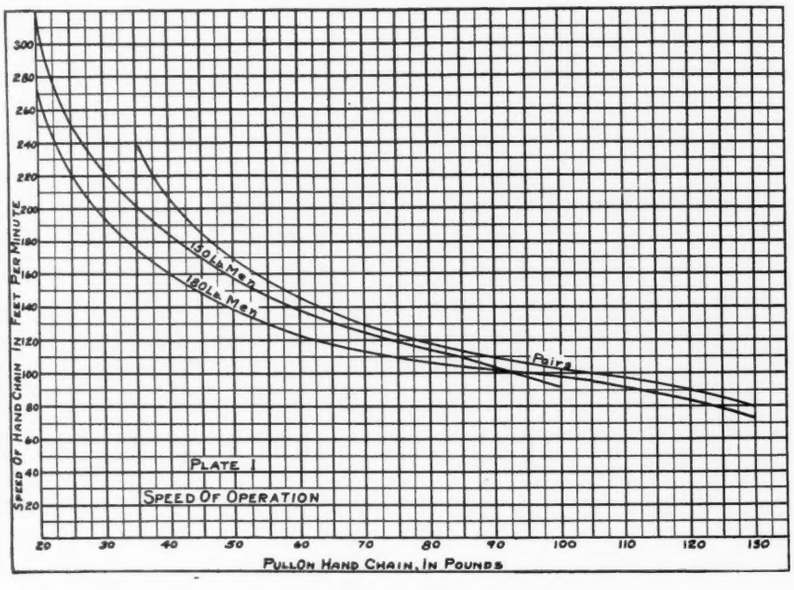

Fig. 1. Chart Showing Speeds of Hand-hoist Operation with Various Amounts of Pull on the Hand Chain

In the recent tests conducted by the Harrington Co., we worked basically from the pull of the operator, which was measured by means of weights attached to the hand chain of a two-ton "Peerless" hoist, these weights being sufficient to just move the load. The amount of the load on the hoist was varied, resulting in proportional variations of effort on the hand chain. The differences were small enough to give a series of results that could be plotted in the form of curves from which intermediate values could be read.

How the Tests were Conducted

The purpose of the tests was explained to eleven employes of the company, and it was made clear to them that each single man, or pair, was to operate the hoist with each of the different loads for a length of time determined only by his or their physical condition, and at any speed or rhythm of body movement that he or they preferred.

It was particularly stressed that the men should avoid competition, and it was suggested that their mental attitude should be that of a worker who had a hoisting operation to perform a number of times each day as part of other work, such as lifting a load onto a high machine. They were told that it was immaterial whether the loads were lifted quickly or slowly, in one continuous operation, or by a series of lifts with resting periods in between. The hoist used in the tests could lift the load 30 feet, and was equipped with a loop of 50 lineal feet of hand chain in which one link was distinctly marked so that stop-watch readings could be taken for each cycle of 50 feet. The tests involved altogether 23,550 feet of hand-chain operation, 153 minutes of actual pulling time, and 1,268,000 foot-pounds of hoisting work.

The operators were divided into three squads according to weight. Three large men, averaging 180 pounds, formed the first squad; six medium men, averaging 150 pounds, the second squad; and eight men, working in pairs, the third squad. After making all the tests, the results were averaged for the several men in each squad and plotted in the form of curves.

Curves Showing Speeds of Operation

The "Speed of Operation" curves reproduced in Fig. 1 show the speed of the hand chain for various amounts of pull. It will be seen from the three curves that the large men in the 180-pound class could exert pulls up to 130 pounds, but that their speeds were slower for pulls below 90 pounds than were obtained by the men in the 150-pound class. For medium-weight men, operating singly, a 100-pound pull was the maximum in the operation of 50 feet of hand chain. Men working in pairs showed only slightly more speed on the heavier pulls than the large single men, but they increased in speed as the loads became lighter.

Endurance and Energy Input Curves

Endurance was determined on the basis of how long the men worked before taking voluntary rests. Observations on this factor are shown plotted in Fig. 2. From the three curves, it will be seen that the endurance of large men is only slightly greater than that of medium-weight men, while pairs of men continue at the job much longer than single men. The endurance was equal for medium-weight single men at 35 pounds of pull, and for pairs at 70 pounds of pull, or 35 pounds each. However, as the amount of pull decreased, the pairs showed greater endurance, probably due to the fact that when the pull was light, each one waited for the other to give the signal to quit.

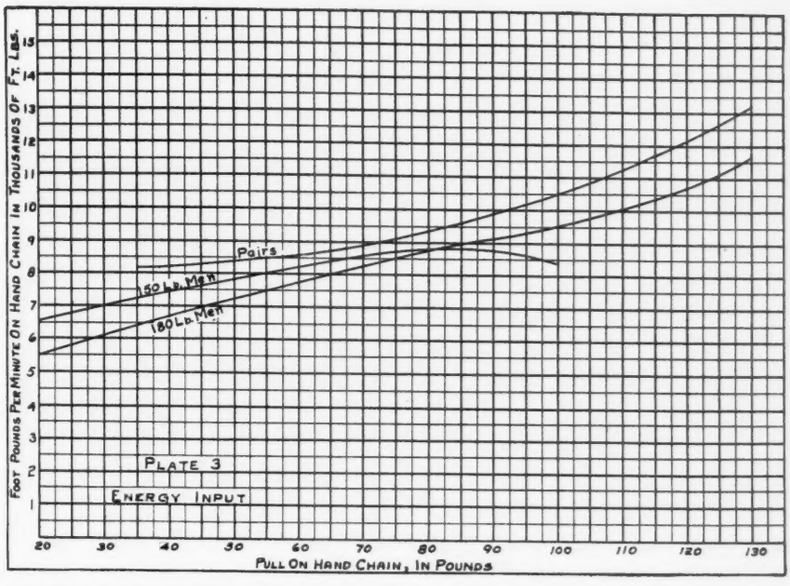
Foot Pounds Per Minute On Hand Chain In Thousands Of Ft. Lbs.
Pairs
150 Lb. Men
180 Lb. Men
Plate 3
Energy Input
Pull On Hand Chain, In Pounds

Fig. 3. Chart Giving the Energy Input of Men Operating Hoists Singly and in Pairs

The relative ability of the three classes of men for hoist operation is shown by the "Energy Input" curves in Fig. 3. Here the foot-pounds exerted per minute of pull on the hand chain are plotted for various loads. The curves are instructive chiefly in showing that large men give less energy for light loads than men of medium weight.

Practical Application of the Data

In using this data to find the actual hoisting speed with any load, it is necessary to refer to the Harrington catalogue, which gives the required pull on the hand chain of each hoist size for the full load, and also the number of feet of hand chain pulled to lift the load one foot, which is known technically as the velocity ratio. The actual pull on the hand chain for a load less than the full rating of the hoist will be in direct proportion to the full-load pull given in the catalogue, as the load under consideration is to the rating of the hoist.

For example, the net pull for lifting a 5000-pound load on a "Peerless" hoist of three-ton capacity, with which a pull of 127 pounds is required to lift the full load, would be $\frac{5000}{6000} \times 127 = 106$ pounds.

Referring to the curves in Fig. 1, it will be seen that a pull of 106 pounds is beyond the ability of average 150-pound men, and that a large, strong man could attain a speed of about 95 feet of hand chain per minute, or a pair of men, a speed of 100 feet of hand chain per minute. Now, in the catalogue data, the velocity ratio for a three-ton hoist is given as 59 to 1, so that the load travel would be $\frac{95}{59}$ or 1.6 feet per minute, with a single strong operator. With a pair of operators, the load travel would be $\frac{100}{59}$ or 1.7 feet per minute.

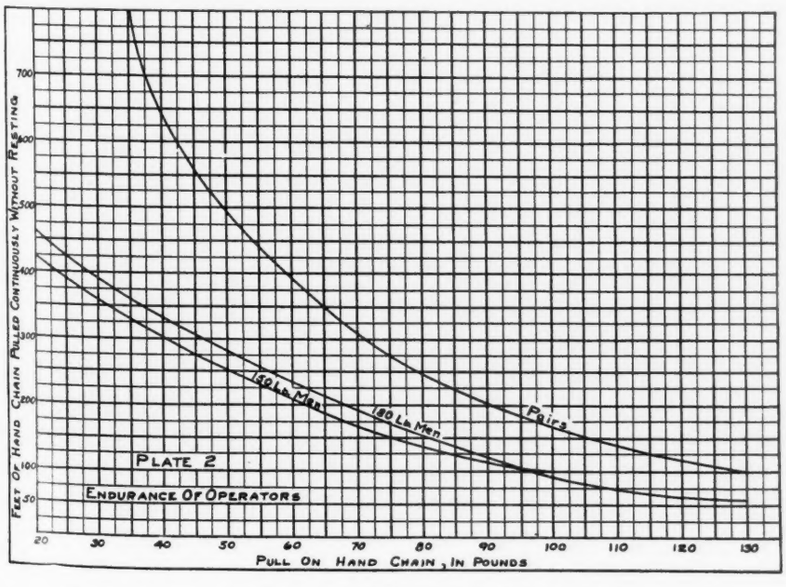

Fig. 2. Curves Indicating the Endurance of Hand-hoist Operators in Lifting Various Loads

If the load were to be lifted a considerable distance, say 6 feet, it would be wise to consult the endurance curves in Fig. 2, which show that at a 106-pound pull a single man can overhaul approximately 80 feet of hand chain without fatigue, and a pair of operators, 150 feet of hand chain without fatigue.

Again, using the velocity ratio from the catalogue, we find that the necessary hand-chain movement for a 6-foot lift is 6×59 or 344 feet. This is too much hand chain to be moved without a rest period at a pull of 106 pounds, and so the hand chain movement for the single operator should be divided into five periods with rests in between, as determined by dividing 344 by 80. In the case of two operators where

$$\frac{344}{150} = 2.3$$

it would probably require three attempts to make the 6-foot lift.

No observations were made of the length of voluntary periods of rest before making second hoisting attempts, but for general purposes, we would assume that the rest period should equal that of the actual hoisting time.

* * *

SPLICING STEEL CABLE SLINGS FOR HANDLING HEAVY MACHINERY

By ALLEN P. CHILD

In the handling of very heavy machinery, it is often necessary to use slings which are formed of rope or heavy chain. In the shops of the Westinghouse Electric & Mfg. Co., an interesting method of forming rings for slings out of steel cable, as shown in Fig. 1, has been devised and is widely used. When it is desired to make a ring of a particular size from a six-strand cable, the circumference of the ring is first established, and then a length of cable seven times longer is cut. Next, the length of cable, cut as shown in Fig. 2, is separated into its separate strands. One of the strands, with its ends wrapped with fine twine to keep the wires from coming loose, is then selected.

At the center of the strand a length equal to the circumference of the proposed ring is marked off so that it can be seen, and the strand is wound into a one-turn circle of the size desired. When the turn is completed, there should be left over an equal amount of the strand at each end. The strands continue to be wound about until one end has been wound entirely around the ring and but one-half turn remains. The same operation is performed with the other end.

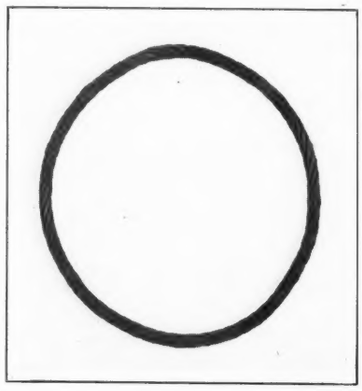

Fig. 1. Spliced Wire Cable Sling for Handling Heavy Machines

A small splicing pin is inserted in the ring where the two ends cross, so as to lift two strands and the end to be inserted in the ring below the pin. This tends to separate the two strands from the other strands, but it may be necessary to insert a larger splicing pin in order to make the space larger and more convenient for the next operation. This consists of turning the splicing pin slowly around in a clockwise direction through the ring as shown in Fig. 3, without permitting it to come out from between the strands.

As the pin is turned it will gradually move forward like a screw and the loose strand will be pushed before it and disappear into the center of the ring. The same thing is done with the other loose strand, and the ring is turned about so as to make the remaining end project away from the operator. When completed, both strands should meet each other and be in the center of the cable ring, which will be of the desired diameter and of the same thickness as the original cable. The ring thus formed has no rough joints, and its flexibility and strength make it well adapted for the purpose for which it is intended.

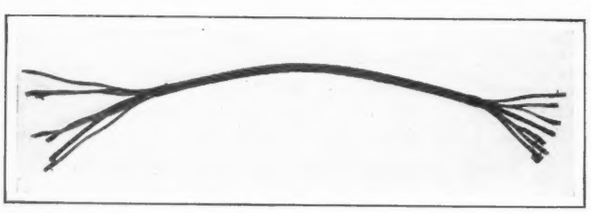

Fig. 2. Steel Cable Separated into Strands from which One is Selected for Making the Ring, Fig. 1

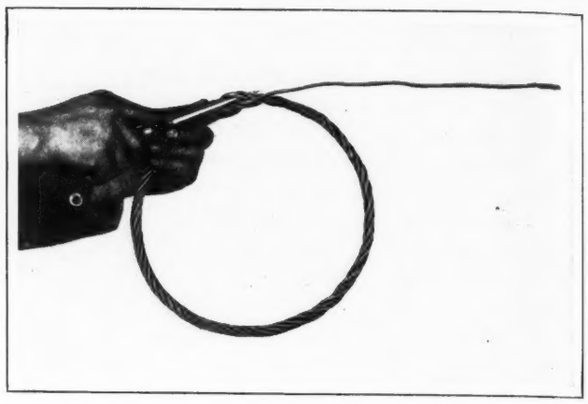

Fig. 3. Making the Splice in the Steel Cable Ring

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INCREASED INDUSTRIAL MACHINERY EXPORTS

According to figures just compiled by the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce, the industrial machinery exports in January, the last month for which complete statistics are available, were the greatest for any month in seven years. The shipments of industrial machinery from the United States were valued at $20,776,000, an increase of 37 per cent over the corresponding month of 1928, and also considerably exceeding the exports valued at $18,636,000 for December, 1928. The monthly average for 1928 was $17,454,000, and for 1927, $15,014,000. The exports of industrial machinery have steadily increased since the close of 1921, and in January this year were more than double the average monthly shipments for 1922.

Of the exports in January this year, the metal-working machinery was valued at $3,118,000 as compared with $2,538,000 during the same month last year. Exports of sheet and plate metal-working machines were nearly double, and the trade in foundry and molding equipment was three times that for the corresponding month in 1928. All the principal classes of industrial machinery made substantial export gains, as compared with a year ago, with the exception of textile machinery, which fell off slightly. The most outstanding gains were in power pumping equipment, oil-well and oil refinery machinery, steam engines, internal combustion engines, and mining and quarrying machinery.

What MACHINERY'S Readers Think

Brief Contributions of General Interest in the Mechanical Field

GIVING NOTICE WHEN LEAVING

To minimize the enforced idleness of machines caused by employes leaving without giving notice, it would be well if employers generally required workers who are about to enter their employ to give sufficient notice to their former employer. This would impress the workman with his responsibility, so that he would realize that the same procedure would be expected of him if he left his new employment.

To insure the practical operation of this plan, it would be well to inform a new man that his reputation as a good workman depends to a great extent upon his manner of leaving a job. To secure the cooperation of the men, the employer, of course, must reciprocate by observing the policy of giving advance notice of lay-offs. G. GREENSTEIN

HELPING EMPLOYES TO LEARN

Well informed men usually do the best work. In any organization it would be of advantage to aid the men in obtaining information on subjects in which they are interested. This can be done by installing an "information box." Announcements may be posted to encourage the men to ask important questions on subjects relating to their work. Question slips should be provided for the purpose. In this way, the employe may be advised to study certain technical books and trade papers, or a course in an evening school may be recommended to him.

Aside from stimulating the employe's desire for information and encouraging him to obtain knowledge, the problem slips give the management a valuable insight into the trend of thought, ambition, and initiative of different men. Even the timid individual who may refrain from asking a verbal question can be encouraged to avail himself of this chance of obtaining advice.

PETER DE PASQUAL

INADEQUATE UPKEEP AFFECTS THE WORKER

The loss in production and economy caused by poorly kept equipment is obvious. Less obvious, however, but even more important, is the effect on the worker of neglected upkeep, uncomfortable surroundings, and inconvenient or unsafe working conditions. Few men like to work in dirty, unsightly surroundings, yet, many plants are not maintained in a condition that would awaken a feeling of pride and interest in the worker. The large losses to production, the harm to industry in general, and the demoralizing effect on community life due to this carelessness, are not fully realized. The data available, however, leave no doubt that every dollar spent for maintenance is well spent. From the standpoint of fire hazards alone, proper maintenance, when figured in terms of life and property saved, is of the greatest importance.

G. H. GUNN

COST DATA FOR EXECUTIVES

The greatest value of cost accounting is in pointing out to the manufacturer where his profits are lost, due to preventable inefficiency in manufacturing or sales methods. A good cost accountant is able to compile information that will show not only where there are inefficiencies and how much they cost, but also what causes them. The reason that most waste due to inefficiency is allowed to continue is because of lack of information as to its cost. The information relating to variations in costs should be given in such detail that an increase in the salary of a shop clerk should be reflected on the cost sheet.

Cost information should be thoroughly predigested before it is handed to the executive, and while the cost data should be given in great detail, they should be supplemental to the cost statements placed before the executive. The statements given to him should be so arranged that the details can be instantly obtained when desired, but at the outset, the executive should not be confused by a mass of figures. A summarized operating efficiency statement brings cost data to a focus for the use of the executive. In a very few figures, this statement gives the essential facts relative to last month's operations, considered from the viewpoint of operating efficiency. JOSEPH VIGGIANO

CONVEYORS AS AFTERTHOUGHTS

During a recent visit to a prominent automobile plant, the writer's attention was attracted by a long overhead conveyor carrying large cylinder blocks to the group of machines that finished them. In response to a comment on this somewhat spectacular sight, the tool engineer of the plant turned to the writer and exclaimed rather impatiently, "Yes, that conveyor never fails to interest visitors. And yet, instead of being an ingenious engineering feat, as most people suppose, it represents quite the opposite. If this shop had been laid out properly in the first place, that conveyor would not have been necessary."

Conveyors have effected large economies in many plants by expediting the transfer of work-pieces through and between departments; and their universal employment for speeding up the assembling of automobiles is a strong indication of their value. However, as shown by the example here mentioned, a conveyor may be an indication of inefficient plant

lay-out, or a successful remedy for lack of proper planning, depending upon the point of view.

OLIVER HERBERT

SELECTING USEFUL INFORMATION

Reading along semi-technical or trade lines broadens the worker's view and makes him a more valuable man in every way. The question is: How can the management help him choose what he ought to read?

One way in which this can be done is through the shop paper, which should contain in every issue a page of suggestions for reading. This section of the paper should classify the various employes, such as factory managers, tool-room workers, gage department employes, hardening department employes, and so on, and should list the titles of articles in the different magazines and trade papers in the library that would be of interest to each particular class. Thus the name of the article and the name of the magazine containing the article would be placed opposite the class of employes interested in that subject. The date and issue of the magazine and the page number where the article may be found would also be listed. This would make a ready reference for every worker in the plant.

HARRY KAUFMAN

WASTING THE SALESMAN'S TIME

Much has been said about the practice of keeping a salesman waiting unnecessarily when he makes a call and the resulting loss to all concerned. There is another phase of the problem that is just as wasteful and as easily avoided, but which is seldom commented upon.

I have in mind the machine user who, when he wants information regarding some detail of a certain line of machinery or information concerning the servicing of machines already installed, instructs his secretary to 'phone or write the machine builder, requesting him to send a salesman to his plant. He gives absolutely no information about what he really wants to know, so the busy salesman, in order to play safe, often makes a call at the expense of urgent business, only to find that information is wanted on some minor point which could just as easily and satisfactorily have been given by telephone or letter.

An indication of the information wanted, if given in the letter or 'phone call, would have saved time and would have enabled the salesman to prepare the actual information wanted more quickly. The salesman could then follow up the subject on his next regular call.

JOHN L. STARR

MAKING GOOD USE OF THE PLANT LIBRARY

The importance of the plant library is generally appreciated by the executives and older employes of an organization. They realize its value in placing before them the existing information on a given subject, so that in initiating a new development they will not attempt to cover ground that has already been gone over.

However, the newer men, particularly in the engineering department, do not always so fully appreciate it. Yet new draftsmen, for example, no matter how experienced they are, will find a great deal of information peculiar to the organization's line of business in such a library. Of course, they get this information piecemeal in the drafting-room, as it applies to their particular jobs, but often without knowing just why certain methods, plans, or materials are to be employed.

The plant library provides a source of just the kind of general information needed under such conditions. Introducing a new man to the librarian, and pointing out technical material which, in a general way, will give him the proper background for the industry or line of products with which he is connected, is well worth while. It is not so much the question of design data, but rather the nomenclature, shop practice, and general history of the industry that he needs most. This he can often obtain by reading books selected from the plant library.

JOHN F. HARDECKER

GROWING WITH THE BUSINESS

Occasionally, a serious shop management problem is the manager himself. Many managers who have worked hard to reach the position they hold, and who have grown up with the business, have helped to solve some of the most difficult problems in the early history of the company. But, unfortunately, some men who are shining lights in a concern during the first years of its life, fail to grow with the business, and the concern becomes bigger than its manager.

A case in point may be cited from a prominent plant in the East. The manager of this company became head of the business when it was very small, at a time when tender nursing was required and strict economies had to be practiced. When he was appointed manager, he was fully qualified to fill the position. The business thrived under his careful guidance, the product manufactured was a good one, carefully made, and the demand increased.

The company's plant grew in size and personnel, but the methods of manufacture, production, control and the supervision did not change. When difficulties were met with, no question arose in the manager's mind as to whether his policies and systems were all right, for "hadn't his systems made the company what it is today?" And so the same policies were continued.

But methods that were true economies for a small concern were gross extravagances for a large one. Things seemed to be in continual turmoil. A general feeling of dissatisfaction prevailed. The employes felt that they were working hard but getting nowhere. The real trouble was that the manager had failed to study the methods of *managing* a large organization while he was working out the methods of *building* a large organization. He had to give way ultimately to a man who could handle the job, to one who, perhaps, would not have been able to do the preliminary work of the pioneer.

AN OBSERVER

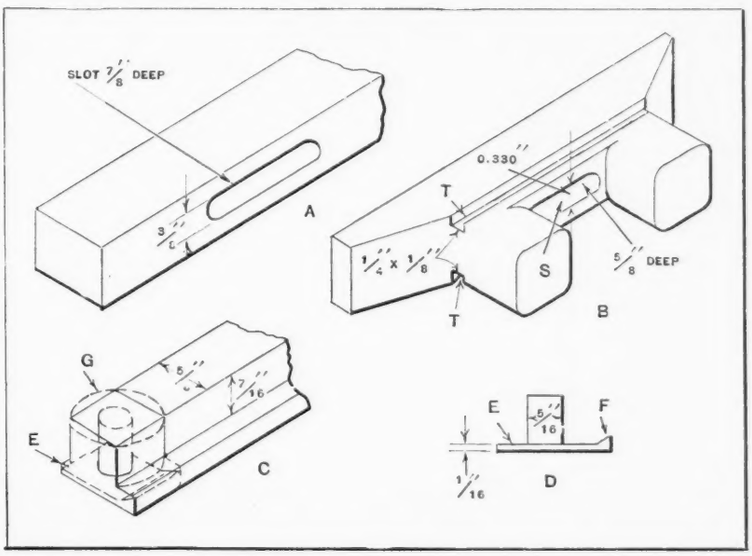
Handling Production Work on a Spline Miller

How a Spline Miller Increased Production on Slotting Operations and Made Possible an Improved One-piece Construction

By DONALD A. HAMPSON

THE possibilities in the application of special-purpose machines to general manufacturing operations are often overlooked. There are many cases, however, in which a machine purchased for a special purpose has been advantageously applied to work originally considered outside its field. This was the case with a 4-inch duplex spline miller bought for use in milling slots in drawn-steel bars such as shown at *A* in the accompanying illustration. The purchase of the machine was made rather reluctantly, as production on the milled part was only about 1500 pieces per year. However, the results obtained with the machine proved the investment to be a particularly good one.

Spline millers of the type purchased have cam-operated table and spindle traversing movements. They are fully automatic, and are designed primarily for such work as chambering operations on firearms, cutting tang slots in machine spindles, sinking keyseats in shafts, etc. The two opposed spindles may work on the same slot, one withdrawing before the other cuts through, or they may work on two separate pieces held in the fixture. Special end-mills of the fishtail type are generally employed.



Examples of Production Work Performed on Spline Miller

The principle of cutting differs from ordinary milling processes in that the cutters are relatively small and run at high speed, while the table moves back and forth very rapidly. At the end of each complete stroke, the cutters are fed in a slight amount. The following speeds and feeds employed on a typical spline miller job will give those unfamiliar with the machine an idea of its operation and adaptability for general machining operations. In the job cited, a 3/8-inch cutter was run at a speed of 1500 revolutions per minute. The table had a travel of 0.020 inch per revolution, and the cutters were fed in 0.005 inch for each forward and backward movement of the table.

Milling Blind Slots

The slots milled in steel bars such as shown at *A* do not pass through the bar, and it was therefore possible to arrange the fixture so that two bars were splined at the same time. For this work, the cutters were run at a speed of 1600 revolutions per minute, and the fastest dial feed was employed. The maximum output on this work was 100 pieces per nine-hour day. The cutters were sharpened after each had cut from sixty to seventy-five splines. They were kept flooded with oil, and produced fine granular chips.

Spline Miller Made Possible One-piece Construction

As soon as the job described was well under way, it became apparent that the new machine offered possibilities in the field of quantity production on some of our so-called "mean" jobs; also that these could be handled with a minimum amount of labor and skill on the spline miller. In one case, this led to the adoption of a one-piece construction for a device that formerly consisted of an assembly of several pieces. At *B* in the illustration is shown the new one-piece construction that was adopted for this part.

It was necessary to cut a blind slot *S* in the cast-iron part *B* between the two posts, which offered some interference to the type of tool ordinarily employed for work of this kind. The over-all length of the cut was 1 5/16 inches. The operator averaged ten pieces per hour on this job, even though he gave most of his attention to another machine. In this case, the cutters were run dry and at slightly higher speeds than for steel. The cutters did not stand up quite so long as they did when machining steel parts, but each averaged 60 pieces per grind.

An interesting phase of this particular job was that the spline miller bettered the time previously made in milling the 1/4- by 1/8-inch longitudinal grooves *T*. With the older method, two pieces were held in a vise and fed against two cutters held on the same arbor with spacing collars between them. The operator did not have time to attend another machine when handling the grooving job by the old method, although he was not kept occupied con-

tinuously. Production was not satisfactory for so simple a job with the former method, due principally to the time that was consumed by the table movements.

Under the new method, a holder was made for the work and two cutters bought for the spline miller. The casting was held in an upright position, and the grooves *T* completed in one part at a single setting in one-half the time required by the old method. On all the cast-iron work, the blanks were run over a grinding wheel preparatory to milling, so that the cutters encountered only skin-free metal.

Special Drilling Operations

Two other jobs were also found to be particularly adapted for machining on the spline miller. One of these was a drilling job on steel parts, using a hand-fed sensitive drill. The positive feed of the spline milling machine cams enabled the production time to be greatly increased in this case, due to the higher rate of feed and the fact that two pieces could be jigged as quickly as one under the old method.

The other job referred to is rather unique, and represents another example of a case in which the spline miller made possible a one-piece construction that was better than anything previously produced. In equipping a new plant, 3000 of these pieces, one of which is shown at *D*, were required as part of the new labor-saving devices. To have the 5/16-inch post machined integral with the thin back, which was approximately 7/8 inch square, involved a number of slow and tedious operations when machined by conventional methods. The spline miller, however, solved the machining problem in an efficient manner.

Hollow-milling Operations

A hollow-mill was used instead of a fishtail cutter in machining the part shown at *D*. In order to try out the method before its adoption, an old milling cutter was turned down until its shank was the correct size for the collet of the spline miller, and a few dummy pieces held by temporary means were machined with this improvised cutter. This experimental work proved so successful that the customer adopted the one-piece construction, which proved to be better and cheaper.

The bars of drawn steel from which parts *D* were machined were first milled as shown at *C*, with the 1/16-inch ledge at *E* corresponding to that at *E* in view *D*. The milled bars were then cut up into pieces of the required length, and the individual pieces taken to the spline miller. The outer dotted circle *G* shows the path of the outside of the hollow-mill, which removed all of the material that was not removed in a following operation by the cutter that produced the wedge-shaped lip at *F*.

Milling Cutter Engineering

Manufacturers and engineers who have brought the modern milling machine to its present state of efficiency deserve much credit for their achievement, but the development of cutters that enable milling machines to produce to the full extent of their capacity is also an engineering achievement that should be given full recognition. The extensive tests, experiments, and investigations conducted by milling cutter manufacturers well deserve to be termed "milling cutter engineering," because this is a field worthy of real engineering ability. The article "Milling Cutter Engineering" in May MACHINERY will describe a number of milling problems that have been solved by special cutter designs.

MODERN MACHINE TOOLS MEET REQUIREMENTS OF NEW CUTTING MATERIALS

From extensive tests that have been made in a large production plant with Carboloy and Widia metal some very interesting conclusions may be drawn. In speaking about these tests, the engineer under whose direction they have been made said: "There seems to be some concern as to how well modern machine tools will stand up when tungsten carbide tools are used. Our experiments indicate that the design of modern machine tools will not be affected to any great extent. In the majority of cases which we have observed, the machine tools that we have used have given a good account of themselves and have proved to have sufficient rigidity and power to carry the load. In other words, the prediction regarding the performance of machine tools has been somewhat upset and has not been borne out by actual tests.

"The older type of machines, say those built prior to 1921, with some exceptions, do not possess sufficient rigidity or power for tools of the tungsten carbide type, but the latest products of the machine tool builder seem to meet the requirements in ordinary machining work. Rigidity is the prime need for the successful use of these tools. If there is not sufficient rigidity in the machine, the tools cannot be used to advantage."

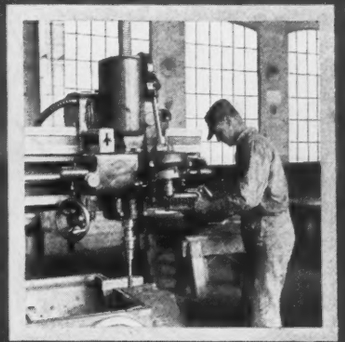
In the experience of the company in whose plant these experiments were made, it was found that there are many operations in which it is possible to obtain a considerable increase in production and reduce the amount of scrap, without increasing the speed of the machine over that used with high-speed steel tools. The saving is due to the fact that less tool grinding is required, and, hence, it is possible to operate the machine at a more continuous rate without stopping to regrind and reset tools. This is particularly true in the case of automatic machines where multiple tooling is used extensively.

While the cost of the material seems high by the pound, there are, nevertheless, several instances where this company has been able to show a definite saving. On some operations, the speed has been increased as much as five times over that previously used, and when that can be done, the saving may be accounted for both on the score of speed of production and the standing-up qualities of the tools.

* * *

Substantial progress was made in 1928 by the railroads in the modernization of their shops. The orders placed last year included 205 more machines than were ordered in 1927. In fact, 87 railroads, representing 85 per cent of the mileage of the roads in the United States and Canada, ordered a total of 2377 machine tools.

Letters on Practical Subjects



AIR-OPERATED CHUCK FOR BRASS CASTING

The air-operated chuck shown in the accompanying illustration is used on a hand turret lathe for machining the brass casting shown in dot-and-dash lines, the surfaces that are finished being indicated by the finish marks. Three equally spaced lugs are incorporated on the back of the work casting, the shape of these lugs being shown at *X*. The face *Y* of these lugs is previously cleaned up on a disk grinder.

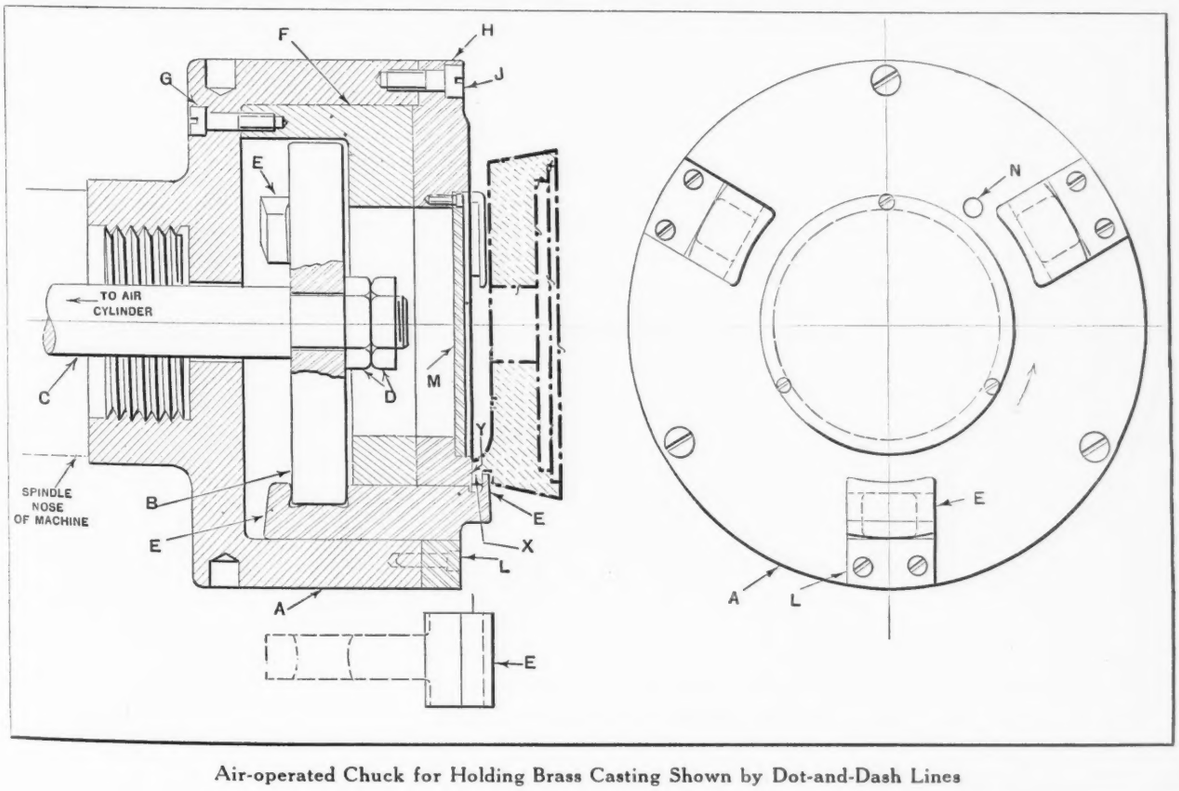
The hollow chuck body *A* is threaded at the back, as shown, to fit the spindle nose of the machine. The hardened plate *B* is clamped against a shoulder on shaft *C* by the nuts *D*, this shaft passing through the spindle of the machine and connecting with a piston working in an air cylinder (not shown). Grooves in three equally spaced hardened jaws *E* fit the plate *B* as shown. The front of these jaws is shaped to fit the channels in the lugs on the back of the casting. The jaws ride in slots cut in the filler plate *F*, which fits the inner diameter of the hollow body *A*, being fastened to it by screws *G*. The hardened front plate *H* is screwed to the face of the body *A* by screws *J*. This plate is notched to receive the jaws *E*, which are backed by the filler plates *L*. A disk *M*, screwed to the plate *H*, serves to keep dirt and chips out of the interior of the chuck.

In operation, the face *Y* of the casting is placed against the plate *H*, so that the lugs *X* clear the jaws. The casting is then twisted in the direction of the arrow, so that the fronts of the jaws *E* enter the channels of the lugs, being stopped by pin *N*. The air pressure is next turned on, forcing the work down against the front plate *H* and holding it securely for the operation.

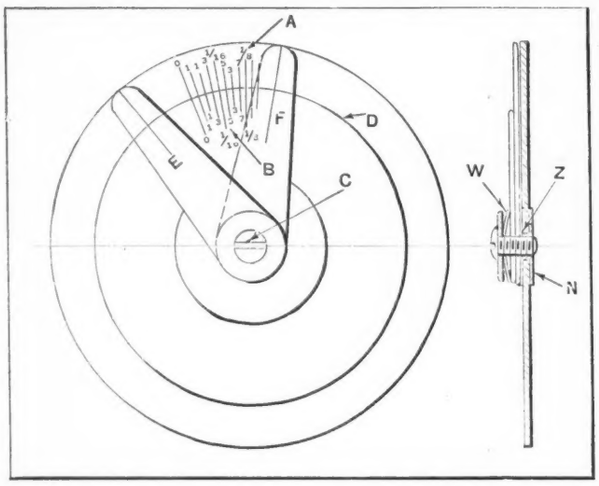
New York City — B. J. STERN

CIRCULAR SLIDE-RULE FOR ADDING FRACTIONS

A circular slide-rule for adding and subtracting fractions is shown in the accompanying illustration. Being circular in shape, it is more compact than the straight type of rule, such as that described on page 652 of May MACHINERY.



Air-operated Chuck for Holding Brass Casting Shown by Dot-and-Dash Lines



Circular Slide-rule Used for Adding Fractions

The divisions of this circular rule are laid out on heavy paper, which, in turn, is glued to disk *D* with any good glue. This will not allow the paper to shrink to any great degree. A circle of about 24 inches in diameter is first drawn, and its center is used as the center of the disk. The spaces are measured with a protractor on the circumference of this circle and are five degrees apart. Lines are then drawn lightly to the center of the circle from each of these points. The size of the disk proper is from 4 to 5 inches in diameter, which will throw the division lines about 1/16 inch apart on the five-inch diameter. Starting with zero, every fourth division will represent sixteenths of an inch, every second division thirty-seconds of an inch, and each division sixty-fourths of an inch. These divisions are numbered, as shown in the illustration, on both sides of the line *D*, at *A* and *B*.

Two arms *E* and *F* are pivoted at the common center *C*, each arm being free to rotate in either direction. These arms are of celluloid or any other transparent material about 1/32 inch thick. Marking points of the hair-line type are scribed in the exact center of these arms, the readings being taken from these lines.

An ideal way of getting just enough pressure on the arms so that they will both turn at the same time, holding any setting which they may have and also allowing them to turn individually, is effected by the pressure washer *W*. The thickness of the bearing nut *N* at *Z* is just sufficient to allow a free movement of the arms about the disk. It also provides a bearing surface for the arms as a counter action to the pressure washer *W*.

The operation of this rule is as follows: Suppose it is desired to add 3/4 and 3/8: Set arm *E* on zero and move arm *F* to the 3/8 inch division; then swing both arms until arm *E* moves from zero to 3/4 on the scale, and read the answer 1 1/8 inches under the hair-line on arm *F*. Continued addition may be performed by moving arm *E* back to zero and repeating the operation.

Subtraction is just the reverse. For example, in subtracting 7/32 from 1/2, set arm *E* on 7/32, arm *F* on 1/2, and swing both arms until arm *F* reaches zero; then read the answer (9/32) under the hair-line on arm *E*. Care must be taken in making the rule to see that the divisions are laid out accurately and that the arms swing from the exact center; otherwise the calculations will not be correct. In the model described the divisions are laid out in different colors, black representing sixteenths and corresponding divisions; green, thirty-seconds; and red, sixty-fourths. This enables a quick and accurate reading to be made.

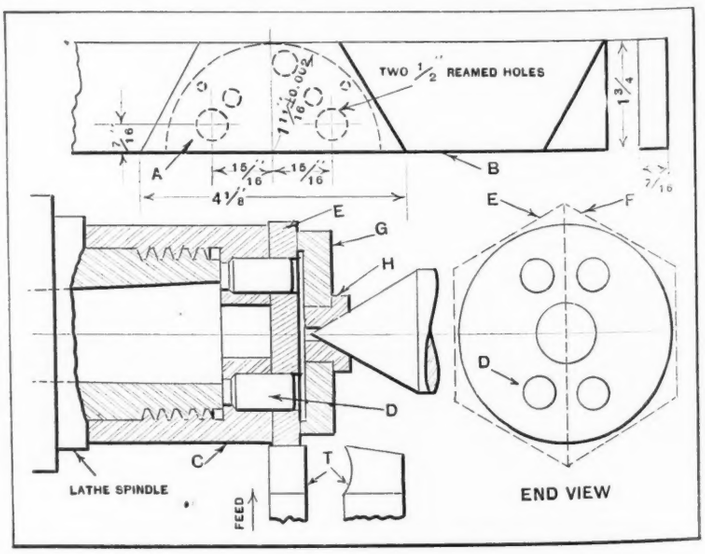
Springfield, Ill. ROBERT C. PEEK

CUTTING SEMICIRCULAR DISKS FROM FLAT STOCK

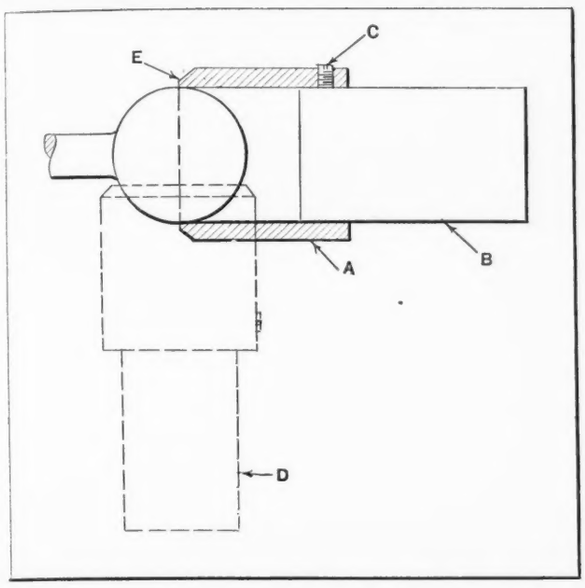
A fixture applied to the spindle nose of a lathe for turning semicircular disks produced from cold-rolled bar stock is shown in the accompanying illustration. The order called for 2000 of these semicircular disks, which were required to be drilled and turned to a radius of 1 11/16 inches, as indicated by the dotted lines at *A*. The full diagonal lines across the flat bar stock *B* show how the material was cut up into semi-hexagonal pieces, which were first drilled and then mounted on the fixture, two at a time, for turning.

The drilling of the holes was done in a suitable jig mounted on a four-spindle machine. The turning fixture *C*, which fits the lathe spindle, has four locating studs or pins *D*, and accommodates two pieces of work *E*, as indicated by the dotted lines in the end view, which shows the amount of stock to be removed by turning. The two pieces are placed on the fixture and held in place by the circular plate *G*, which is provided with a hardened tool-steel center *H*. This plate is held against the work by the tailstock center. A tool *T*, 1/2 inch wide, which is ground with a lip, as shown, was used for the turning operation. The hand cross-feed was employed and a stop used to maintain uniform size. The production obtained with this equipment was eighty pieces per hour.

Syracuse, N. Y. H. L. WHEELER



Fixture Used in Turning Semicircular Disks



Tool for Sizing or Finishing Brass Balls

TURNING SMALL BRASS BALLS

The writer read with interest the description of a ball-turning attachment on page 182 of November MACHINERY. A method of turning small balls that involves less expense for equipment is as follows: First turn the balls to about 0.005 inch oversize with a forming tool, and then use a tool like the one shown at *A* in the accompanying illustration for finishing the balls to the required size.

Tool *A* is cylindrical in shape and is hardened and ground on the inside to the finished diameter of the balls. The handle *B* is held in place by the set-screw *C*. The tool is easily sharpened by grinding the end *E*, care being taken to keep the end square with the longitudinal axis. With a finishing or sizing tool of this kind it is practically impossible to turn a ball under-size, as the inside diameter of the tool is the same as the finished diameter of the ball.

The finishing or sizing cut is started with the tool in the position shown by the full lines. No difficulty is experienced in holding the tool in the hands while it is swung around to the finishing position, shown by the dotted lines at *D*. If lard oil is used as a cutting lubricant and the tool kept sharp, the finished balls will have smooth surfaces.

Philadelphia, Pa. C. KUGLER

CUTTING COST OF SHELL BY USING TWO-PIECE CONSTRUCTION

The one-piece drawn shell shown at *A*, Fig. 1, is made from 0.035-inch cold-rolled steel of an expensive grade intended for extra deep drawn products. This shell requires a blank 8 3/8 inches in diameter, and is produced in four operations, namely, blank and draw, redraw, trim, and pierce. Besides the three holes in the top of the shell, there are also two small slots *E* in the side for fastening an etched nameplate. Had it not been for these two slots, the top perforations could have been put in during the second or redraw operation, thus eliminating the piercing operation.

The actual cost of the completed shell, including the nameplate and black-baked enamel finish, is very nearly 7 cents each, when produced in large quantities. After shaving costs as much as possible on all other parts assembled in the shell, the cost of the complete product was still more than 2 cents a piece, too high to enable the company to obtain a desirable contract. It was evident that the mechanism could not be cheapened or simplified any further without danger of affecting the proper functioning of the product. It was necessary, therefore, to cut the excess production cost from the cost of the shell, which serves simply as a case or housing for the mechanism.

Drawing a shell to the dimensions shown at *A* is impossible unless the very best grade drawing steel is used. In order to be able to use a less expensive stock, it was decided to make the shell in two pieces, as shown at *B*. This construction proved practical, and enabled the production cost to be lowered 2 cents or more per piece, thus enabling the company to obtain the desired contract.

It may be of interest to note here that 70.141 square inches of stock was required to draw the shell shown at *A*, and that the cost of the material alone was 3 3/8 cents per shell, while the two-piece shell shown at *B* requires a total of only 51.385 square inches of much cheaper stock. The saving of 18.756 square inches, or about 27 per cent, in the amount of material alone, aside from the difference in price of the two metals, was an important factor in an order of the size involved.

The two-piece case, shown at *B*, consists of a shallow shell *C*, 5/8 inch deep, which is blanked, drawn, perforated, and lettered by a compound die, and the body *D* of the shell, which is formed and seamed from a blank 2 5/8 inches wide by 12 inches long. The seam in the body *D* is made on the inside of the shell, so that the outer surface is smooth.

The members *C* and *D* are assembled and firmly fitted together in the die shown in Fig. 2. The cylindrical body *D*, Fig. 1, is placed over the expanding body *E*, Fig. 3, which consists of six segments assembled on a tapered plug *F* and held in place by the coil spring *G*. The included angle of the taper on plug *F* is 60 degrees.

The cover *C*, Fig. 1, is placed over the part *D*

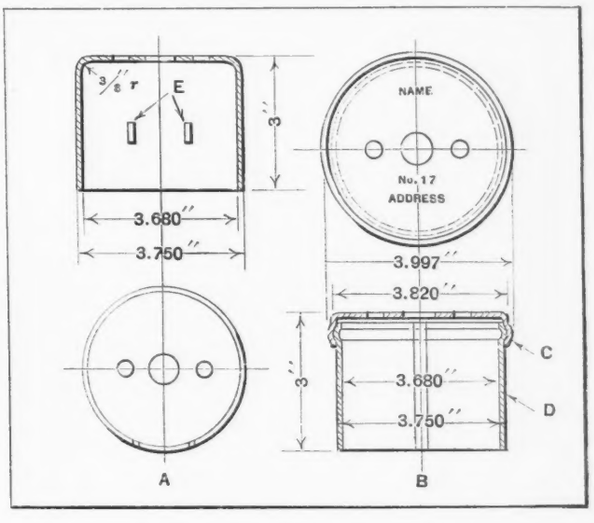


Fig. 1. (A) One-piece Drawn Shell; (B) Two-piece Assembled Shell

located on member *E*, Fig. 3, and the press tripped. The descending ram carries the punch *H* which has two cam members *I* that make contact with the corresponding cam faces on the slides *J*, causing these members to close in and form the bead which holds the two parts of the shell together. The end of punch *K*, coming in contact with the work, expands die *E*, causing the latter member to press the bead of the assembled joint outward into the groove formed in the slides *J*.

Fig. 2. Two-piece Shell

The spring *G* causes the expanding plug to collapse when the punch moves upward so that the assembled shell can be removed from the die. Four studs *S*, only one of which is shown in Fig. 3, serve to withdraw the beading slides *J* when the upward movement of the press ram withdraws the cam punches *I* from the die. The completed two-piece shell, as shown in Fig. 2, has a baked enamel finish which gives it a very pleasing appearance.

Adrian, Mich. FRANK V. KEIP

COMBINATION DIE FOR PIERCING, LANCING, AND FORMING SHELLS

A die for piercing a central hole through the top of a brass shell, stamping on top, piercing a hole through the side, lancing the side opposite the lateral hole, and bending this lanced portion to a definite form, all during one stroke of the press, is shown in the illustration on page 605. The shell, which is a cover for a commercial electric tool switch, is shown at the right in the illustration. Before this die was designed, three dies were required to perform these operations.

Die *A*, which locates the work, is sunk slightly in block *B*, to which it is fastened by screws and dowels. Block *B* is bolted to the die-holder *C*. The

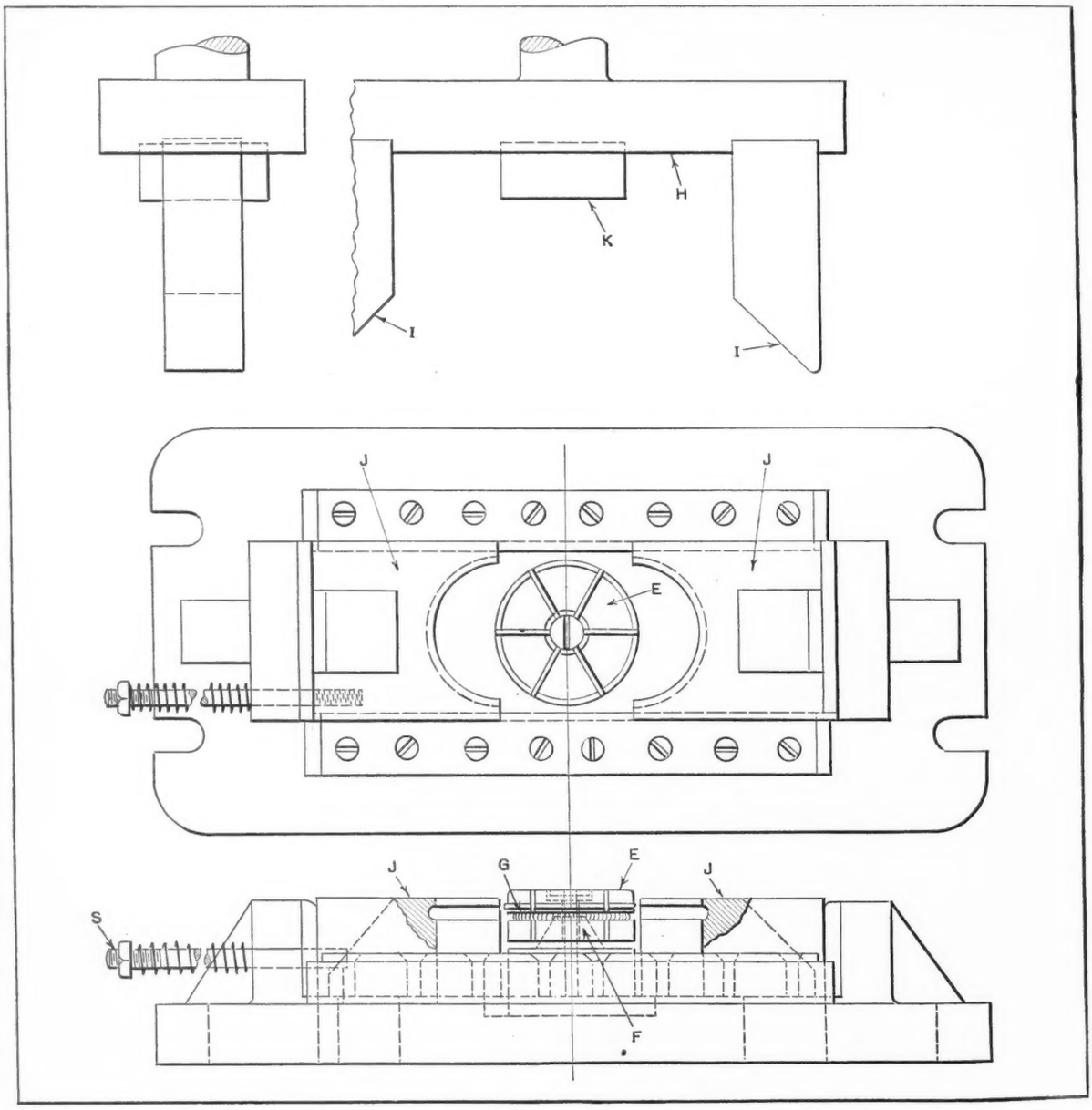


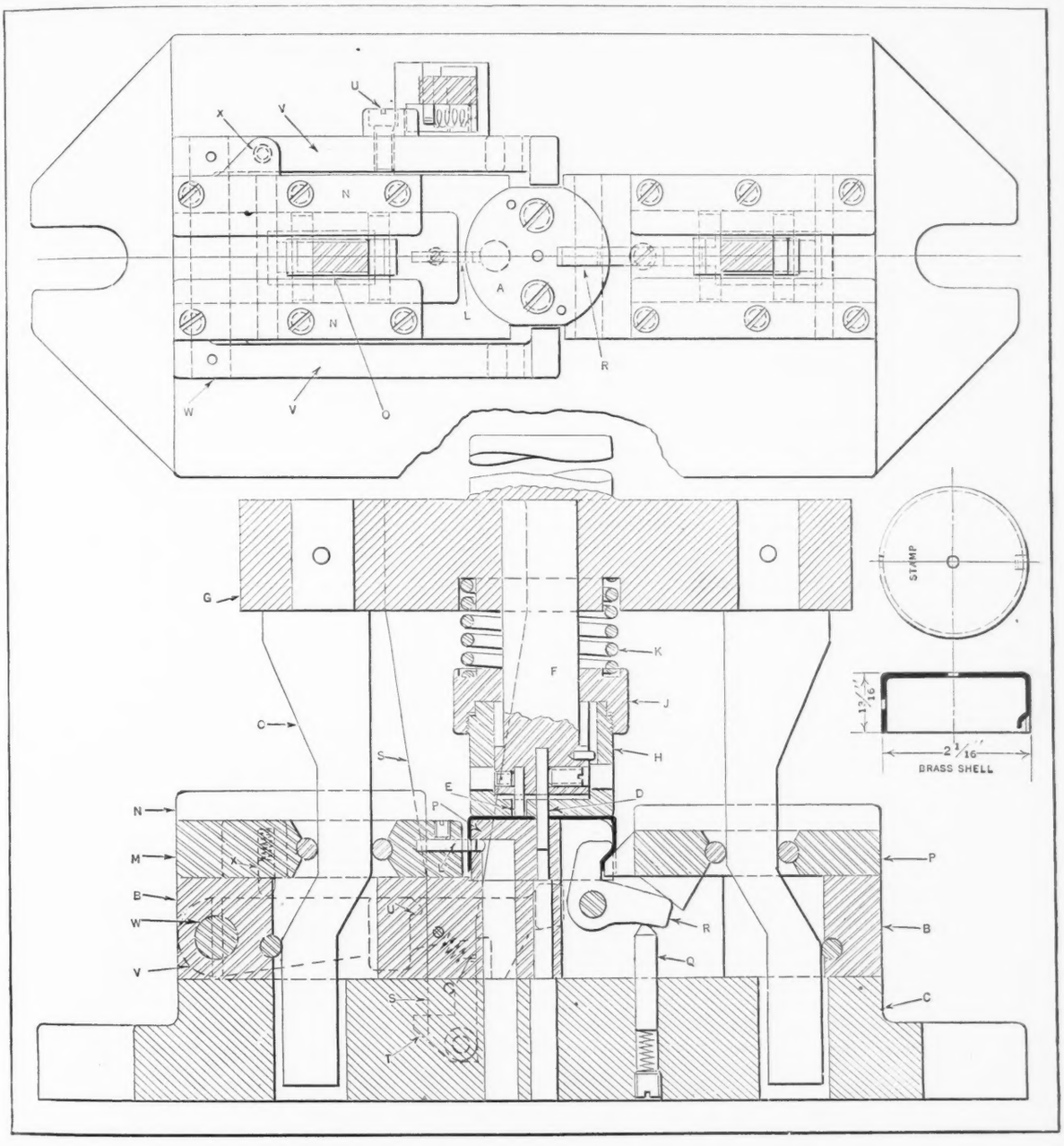
Fig. 3. Beading Die Used in Assembling Shell B, Fig. 1

punch *D*, made of hardened drill rod, and the stamp *E* are fastened in the punch-holder *F* by set-screws. The punch-holder is a snug fit in the punch-block *G*, and is held from being pulled out by means of set-screws.

The combination pad and stripper plate *H* and its cap *J* are a silding fit on the punch-holder. These are prevented from turning by a dowel-pin, which projects from the side of the punch-holder and engages a groove in the stripper plate. Pressure is exerted on pad *H* by a spring *K*, one end of which is contained in a groove in the cap *J*, and the other end in a groove in the punch-block.

The side of the shell is pierced by punch *L*, which is held in the slide *M*. This slide is guided by the two gibs *N*. The slide carrying the punch is caused to move forward and backward by the cam *O*, which bears against hardened pins driven through the slide on each side of the cam. A similar pin driven through the die-block *B* serves to support the lower end of the projecting cam when it is moving the slide forward. The cam is fastened to and moved up and down by the punch-block *G*.

The side-lancing of the shell and the forming of the portion lanced is performed simultaneously with the piercing of the lateral hole. The slide *P* is guided and moved in its forward and backward motions exactly as described for the piercing punch-slide. The front end of this slide lances or shears the shell, and it is also shaped to form the lanced portion. An inclined projection from the bottom of the slide, in moving forward, strikes one end of the pivoted angle-piece *R*. The opposite end of the angle-piece is shaped to back up the lanced piece being formed. After the lanced portion is formed and slide *P* withdrawn, the angle-piece *R* is rotated by the spring-actuated plunger *Q*, so as to allow the shell to be ejected from the die.



Combination Die for Piercing, Lancing, and Forming Brass Shells

Fastened to the punch-block is an arm *S*, attached to the lower end of which is a pawl *T*. On the upper stroke of the press, the end of the pawl *T* engages the projecting end of the hardened lug *U*, which is fastened to one of a pair of ejecting arms *V*. These arms are both pinned to and swing together on shaft *W*. The pawl continues to engage the lug until the free ends of the arms eject the shell from the die. At this height the pawl slips off the lug and allows the arms, assisted by the spring-actuated plunger *X*, to return to their original position. Pawl *T* is pivoted and held against a stop-pin by a spring, so that it may swing past the fixed lug *U* on the downward stroke of the press. Compressed air is used to eject the shell from the top of the die. This die increased production 270 per cent.

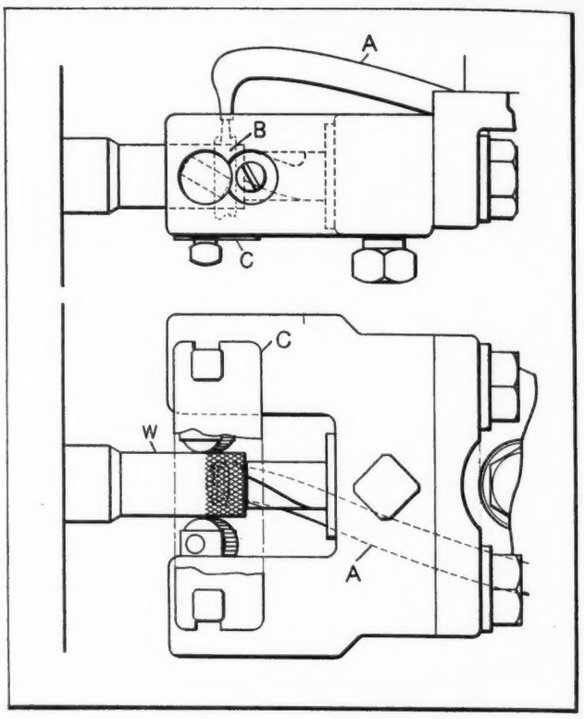
Fairfield, Conn. J. E. FENNO

OIL SHIELD PROTECTS KNURL ROLLS FROM CHIPS

In making the steel product shown in process at *W* in the illustration, a long knurling job was combined with a deep drilling operation. No matter how the drill was ground, small, broken chips were formed, some of which would be carried along by the oil until they got under the rolls. The resulting damage to the knurling necessitated scrapping a certain percentage of parts.

Different expedients, including various ways of grinding the drill and about every conceivable combination of the force, direction, form, and angle of the oil stream by which the condition could be improved were tried. Finally the writer decided to try the arrangement shown, in which a second concentrated oil stream issuing at about right angles to the main supply and directly behind the knurl rolls is employed, with the idea of producing a standing ring or "welt" of oil which will act as a shield.

This plan cost nothing to try and instantly proved successful. A copper pipe *A* from the turret oiling attachment was brought around the rear side of the knurl tool, from where it directed a flat vertical stream against the product. The resulting "welt" *B* of oil cuts up the "tongue" from the main lubricating stream formed at the bottom side of the product and prevents the passage of any chips forward. The loss from defective knurling immediately dropped to nearly nothing.



Knurl Rolls Protected by Oil Shield

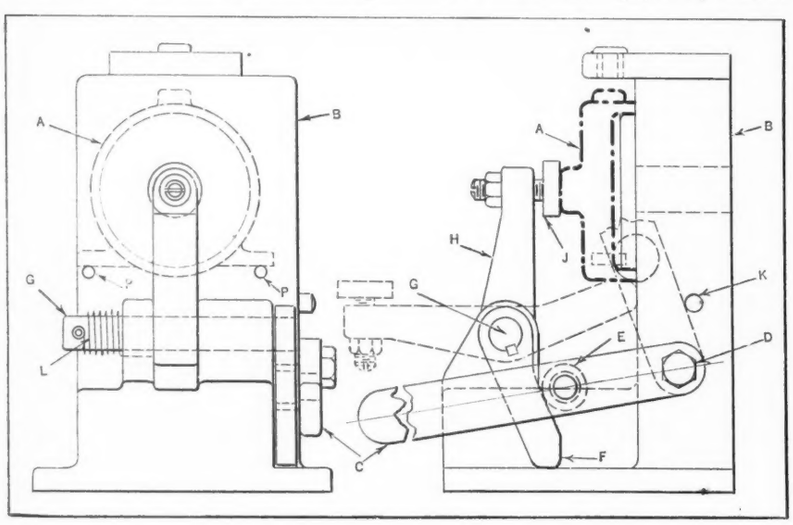
In order to prevent any oil from the auxiliary stream from spurting out in front when indexing, a shield of thin spring bronze *C*, slotted at the ends to fit the adjusting screw lock-screws, is clipped over the front end of the knurl-holder. This can be instantly removed or replaced by springing it with the fingers, and causes no interference of any kind.

Jena, Germany HENRY SIMON

QUICK-ACTING JIG CLAMP

The clamping arrangement shown in the accompanying illustration clamps the die-casting *A* in the jig *B* by one downward motion of the lever *C*. The jig itself is of the simple angle-plate type, with a plate projecting from the top to hold the drill guide bushing. The die-casting is located by a plug on the angle-plate, and aligned with the base of the jig by two pins *P*.

The lever *C* pivots at *D*. On the lever is mounted a roller *E*, which bears against the cam arm *F*, keyed to the shaft *G*. To this shaft is also keyed the clamping arm *H*, so that a downward motion of the lever *C*, in causing the cam *F* to rotate by pressing the roller *E* against it, will also rotate the arm *H*. To the outer end of this arm is attached a swivel block *J*, which may be adjusted to give the required clamping pressure.



Drill Jig Equipped with Quick-acting Clamp

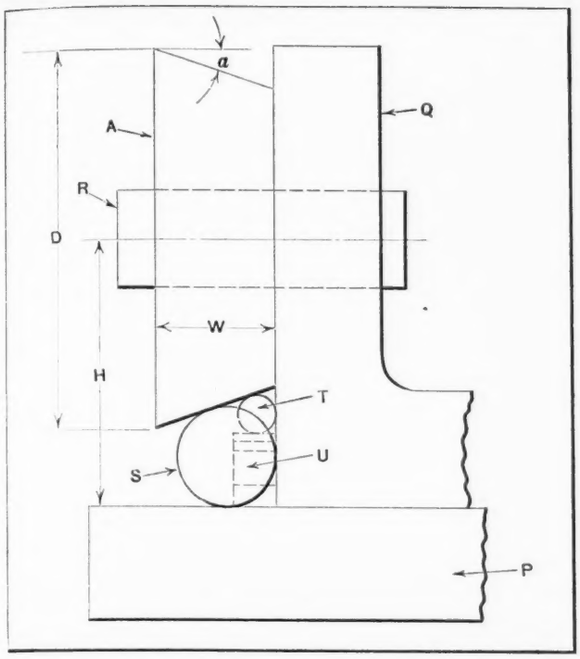


Fig. 1. Method of Checking Angle and Diameter of Tapered Disks

The clamp is released by pulling lever *C* up until it touches the stop-pin *K*. The clamping arm and the cam arm, through the action of the spring *L*, are then caused to take the positions indicated by the dotted outline in the side view. With the clamping arm in this position, the jig may easily be reloaded.

Seattle, Wash. CARL E. SCHINMAN

MAKING AND CHECKING TAPER GAGE

It is a comparatively simple matter to make an accurate taper gage of the plain wedge type, but when, in addition to the taper, the sides are beveled, the problem of machining and checking the accuracy becomes more difficult. In Fig. 2 is shown a master gage for use in checking working gages of the male bevel-side taper type. The master gage consists of the plate *E* and the two beveled edge pieces *F* and *G*.

The plate *H* and the two disks *J* and *K* are used in locating the pieces *F* and *G* on plate *E* when the master gage is being assembled. Plate *H*, with its two disks, is, of course, removed from the master gage to permit testing the accuracy of a working gage by placing it in the master gage. If the ends of the working gage are flush with the ends of plates *F* and *G* and the beveled sides make good contact, the gage passes inspection satisfactorily.

The feature of particular interest regarding the master gage is the simplicity of its construction. The plate *E* and pieces *F* and *G* are made first, the two latter pieces being ground to the required angle of 20 degrees and checked with a sine bar. An allowance is made for grinding the ends *W* and the opposite ends to give the required finish dimension of 3.500 inches after the gage is assembled. Base *E* is counterbored and drilled to allow sufficient clearance for adjustment.

In making the disks *J* and *K*, the diameters are calculated to give the required taper of 5 degrees when spaced exactly 3.000 inches apart. The plugs *L* are ground to fit the arbor holes in the disks and set exactly 3 inches apart in the plate *H*. One of the most difficult problems encountered in making a gage such as described is to check the accuracy of the diameter and the taper of the disks. A novel and satisfactory method of doing this is illustrated diagrammatically in Fig. 1. The equipment required consists of an accurate surface plate *P* and angle-plate *Q* having two accurate faces located at right angles, a ground plug *R*, a 1-inch plug gage *S*, a 0.400-inch plug gage *T*, and size-blocks *U* to raise gage *T* the calculated distance above the surface plate.

With the diameter *D*, angle *a*, and thickness *W* given, it is an easy matter to calculate the required height of the size-blocks *U* and the height *H* of the plug *R*, for checking the accuracy of the diameter and angle of the disk. It is obvious that when the disk is correctly machined and the gaging equipment is accurately set up, as indicated, plugs *S* and *T* will slide easily into place with just the right "feel" or contact. In testing the smaller disk, the plug gages *S* and *T* are simply raised the required amount to make up the difference between their respective radii. The important feature of the testing method described is that it permits the diameter and angle to be tested simultaneously.

The disks *J* and *K*, Fig. 2, mounted on the 1-inch plugs *L*, spaced 3 inches apart on plate *H*, are held in place by screws *M* as shown. The screws *N* which secure pieces *F* and *G* to the plate *E* are loosened, and the disks attached to plate *H* placed in the position shown in Fig. 2. The pieces *F* and *G* are then adjusted to give suitable contact with the disks, and clamped in place. Plate *H* is also held in place by a clamp. An indicator applied to

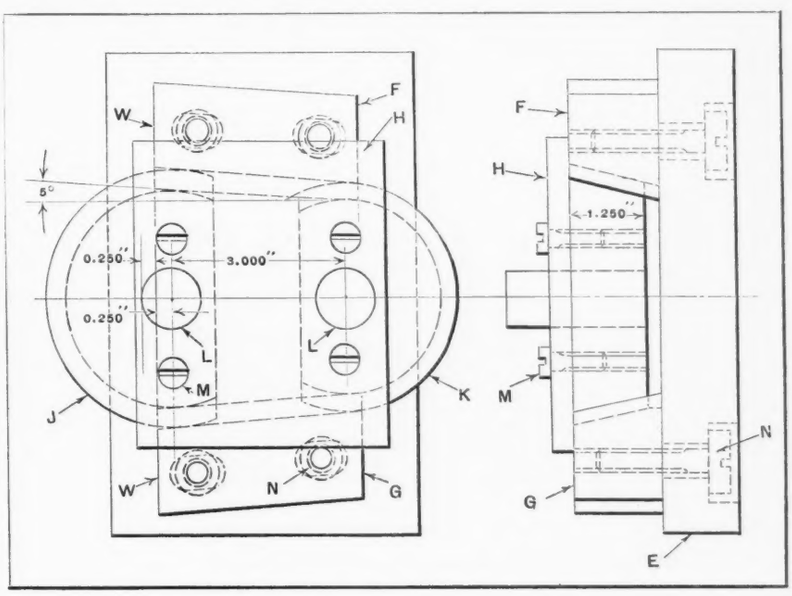


Fig. 2. Master Taper Gage with Setting Disks in Place

the plugs *L* permits the disks to be located in the proper position with respect to the gage pieces *F* and *G*.

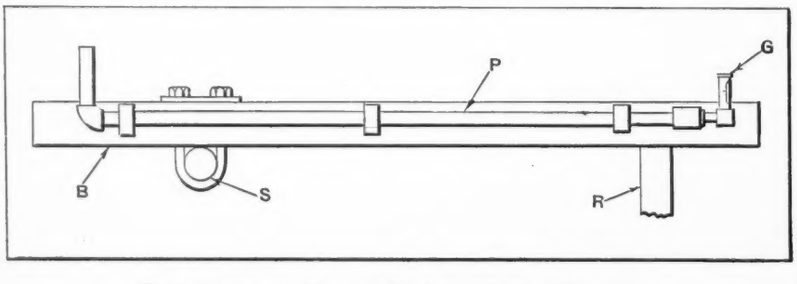
The ends *W* of pieces *F* and *G* are then ground until a reading with an indicator attached to a vernier height gage shows this surface to be 0.250 inch lower than the top of plug *L*. The opposite ends of pieces *F* and *G* can now be ground to give the required width of 3.500 inches, which can be readily measured with a micrometer. Plate *H* is, of course, removed when pieces *F* and *G* are being ground on plate *E*.

Stamford, Conn. JOSEPH E. ABBAZIA

ALIGNING SHAFT WHEN CUTTING INTERMITTENT KEYWAYS

The keyway locating fixture described on page 47 of September MACHINERY brought to mind a device originated for a similar purpose in a small out-of-the-way shop. As usual in such cases, there was no suitable equipment for handling the work, which demanded a high degree of accuracy. The aligning device which was improvised for this job and proved satisfactory, is shown in the accompanying diagram. It consists primarily of a wooden beam *B* secured by U-bolts to the shaft *S* in which the keyways are to be cut, and a length of pipe strapped to the beam. At one end of the pipe is an elbow carrying a short piece of pipe located in a vertical position. At the other end is an oil gage *G*. Water is poured into the pipe until the surface reaches a mark scribed on the body of the gage.

When the shaft is reset for cutting another keyway, it is adjusted until the liquid in the gage is level with the graduation mark. The dimensions of the device are such that a variation of 0.001 inch in the angular position of a keyway represents a change in the water level of 1/32 inch with respect to the reference line. The strut *R*, nailed to the end of the beam, extends to within about 1/4 inch of the floor and prevents the beam from being filled enough to permit any of the water to run out of the pipe. This is obviously a necessary precaution, as any change in the volume of water would affect the accuracy of the setting.



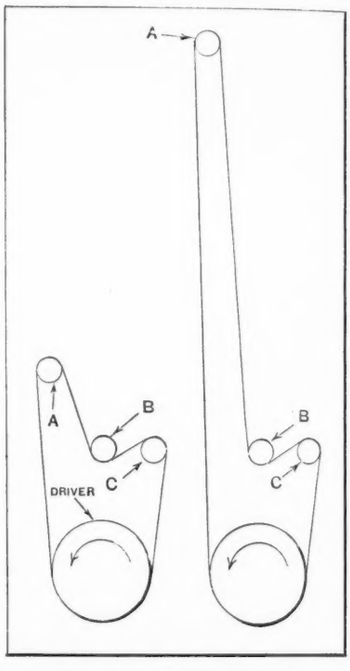
Device Used in Aligning Shaft for Cutting Keyways

Willimantic, Conn. HERBERT A. FREEMAN

HOW BELT TROUBLE WAS OVERCOME

In the plant with which the writer is connected, a machine was designed with a belt drive, as shown in the diagram at the left in the accompanying illustration. The total length of the belt in this drive was 7 feet. Although the drive was satisfactory as far as transmitting properties were concerned, the life of the belt was quite short, failure taking place in the cemented joints of the belt. The driven pulleys *B* and *C* were 3 1/2 inches in diameter, with a center distance of about 4 1/2 inches. The operating speed of the belt was about 500 feet per minute.

After experimenting with various makes of belting without securing satisfactory results, the idler pulley *A* was raised, as shown in the diagram at the right, so that the length of the belt was increased to 22 feet. This reduced belt failures to a minimum, owing to the fact that, although the driving conditions are practically the same, there are fewer flexures per minute in any given length of the belt.



Belt Drive Arrangements

Although the initial cost of the longer belt is greater, this is offset by fewer shutdowns for repairs, which eventually results in a saving. While there is nothing startling in such a change in a belt drive, nevertheless, it is a point that is frequently overlooked by designers. In an effort to secure a compact assembly, belt lengths are sometimes cut to the minimum length, with the result that they operate inefficiently, whereas a longer belt will have longer life and may be operated at less tension without danger of excessive slipping.

Philadelphia, Pa. R. H. KASPER

* * *

THE ENGINEERING INDEX

It may be of value to many engineers to know that the Engineering Index Service provided through the activities of the American Society of Mechanical Engineers is now available in several large public libraries, including those of Newark, Cleveland, Bridgeport, Baltimore, and the John Crerar Library of Chicago. This Engineering Index Service reviews and indexes 1700 engineering journals from all over the world, including, of course, MACHINERY. Engineers and others in the mechanical field who wish to learn what has been published on any engineering subject anywhere in the world, will find reference to this index of great value. The index is published by the American Society of Mechanical Engineers as a service to the engineering field at a considerable expense to the society. Such a service could not be rendered by any commercial enterprise.

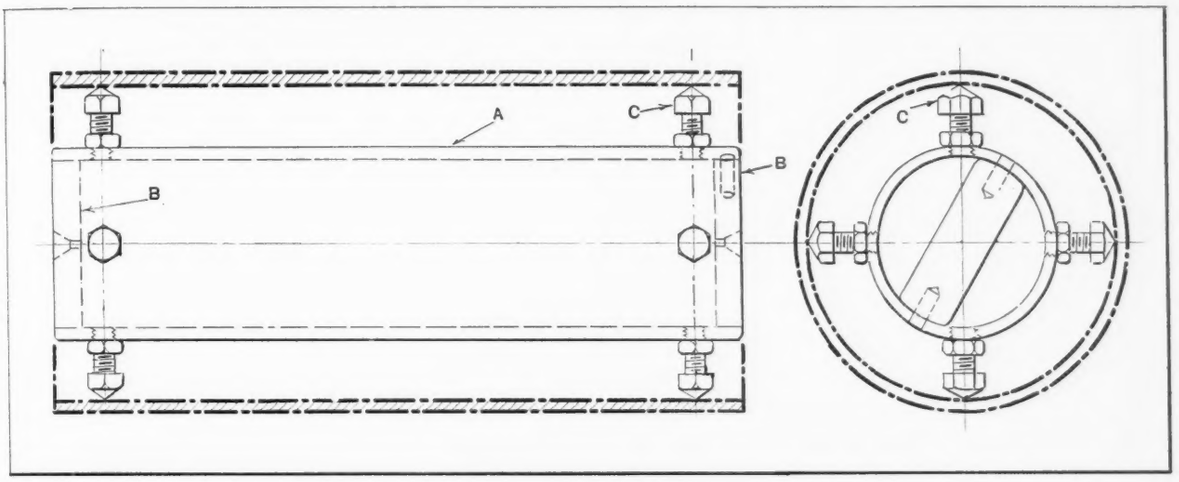
Shop and Drafting-room Kinks

CAT-HEAD ARBOR FOR TURNING PIPE

A cat-head type arbor devised by a machinist for use in turning a small lot of cast-bronze cylinders is shown in the accompanying illustration. The requirements in machining the outside of these cylinders were that the parts should have an even wall thickness and that no cut be taken on the inside.

The arbor or cat-head illustrated was made from a piece of ordinary water pipe *A* by placing two bars *B* across the ends to provide centers, and tapping four holes in each end to receive the hexagonal-head bolts *C*. By adjusting these bolts, it is possible to true up both ends of the casting so accurately that the cylinders are all held within the required limits of concentricity.

South Plainfield, N. J. H. C. KLINE



Cat-head Arbor Used in Turning Outside of Bronze Cylinder or Pipe

HAND-OPERATED TUBE-FORMER

An extremely simple method of making light tubing from thin strip stock is as follows: Drill a hole in a piece of cold-rolled steel, and fasten this piece of steel securely in a vise. Form one end of the tubing by hand, and push this formed end through the hole in the cold-rolled steel. Then grip the formed end with a pair of pliers and draw the tubing through the hole.

Philadelphia, Pa. C. KUGLER

TRIANGLE FOR DRAWING PARALLEL LINES

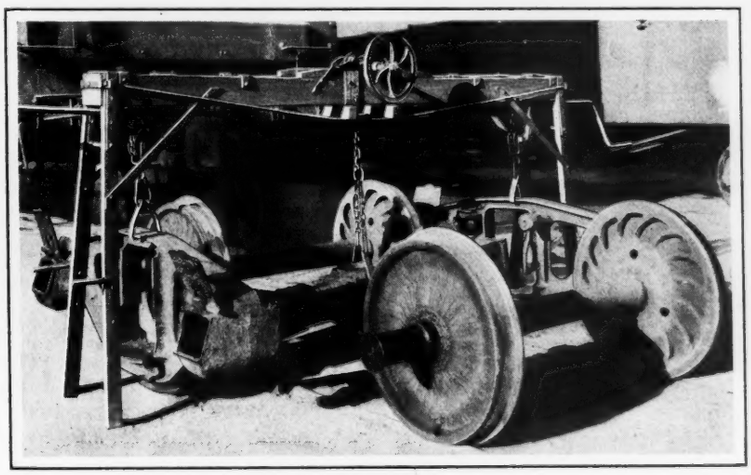
An ordinary draftsman's celluloid triangle with sixteen parallel lines scribed on one side parallel with one of the edges, and spaced 1/16 inch apart, will prove a useful addition to the draftsman's outfit. It can be used to draw lines parallel to another line by placing the triangle on the drawing with one of the scribed lines coinciding with the line on the drawing.

H. R. BOWMAN
Baltimore, Md.

JACK FOR RAILROAD TRUCK SIDE FRAME AND BOLSTER

A number of portable jacks like the one illustrated have been made up by the Southern Pacific Co. to facilitate handling the heavy side frames and bolsters of railroad car trucks. The horse or jack is placed at the end of the car from which the truck is to be removed. The end of the car is jacked up and the truck run out from under the car and located directly under the horse. The side frames are next raised and swung outward so that they clear the axles, after which the bolster is raised sufficiently to permit the wheels to be moved away. The jack used in picking up the bolster is provided with a handwheel that was taken from the brakeshaft of an old railroad car.

C. W. GEIGER
San Francisco, Cal



Portable Jack Used in Removing Railroad Truck Side Frame and Bolster

Questions and Answers

MAKING FLAT WASHERS IN QUANTITY

W. B.—What is the most economical way to produce flat washers in quantity? In a progressive die, there is a tendency for the washers to become cup shaped; how are they kept flat? In using a compound die, if more than three are made at one time, I have had difficulty with the washers dropping back on the die; also, the dies clog up because the washers stick to the top part. Would readers of MACHINERY suggest means for overcoming these difficulties?

CEMENT FOR WATER-COOLED WELDING ELECTRODES

W. E.—We frequently need some kind of cement, or a material that can be used in place of a cement, in the assembling of tips for certain electrodes or fittings that screw into the electrodes. The electrodes are of copper, and the fittings and tips are of the same material. Often we find it necessary to make special electrodes that require threaded joints. These electrodes are usually of the water-cooled type, and we experience difficulty at times in obtaining an absolutely water-tight joint, the water pressure sometimes being as high as 60 pounds per square inch. This difficulty is especially noted when we are using straight threads bottoming in the adjacent part.

We would like to obtain information about a cement that would be waterproof and at the same time able to resist a high temperature.

Answered by H. M. Badger, General Superintendent, Stanley Insulating Co., Great Barrington, Mass.

I would suggest trying a mixture of litharge and glycerine, adding sufficient glycerine to the litharge to form it into a suitable paste.

MISREPRESENTATION OF AGE BY MINOR SEEKING EMPLOYMENT

A. M.—A boy twelve years of age represented himself to be fourteen, and was employed in a factory where the law required such employes to be at least fourteen years old. Did the false statement of the boy as to his age relieve the employer from liability for employing one under the age fixed by law?

Answered by Leslie Childs, Attorney at Law, Indianapolis, Ind.

By the seeming weight of authority, an employer is not justified in relying solely upon the statement as to age made by a minor, when the law requires that such employes be a certain age. It is the duty of an employer to go beyond this in ascertaining the truth of the representation. (214 ILL. 509). Further, some Courts have held that even a false affidavit signed by a third party, in respect to a minor's age, will not excuse an employer for his unlawful employment, but that an employer acts at his peril in ascertaining the age of the minor. (87 N.E. 229). Other Courts have held that an employer is only bound to exercise proper vigilance and due caution in ascertaining the age of a minor applicant, and if proper vigilance and due caution have been exercised, the employer will be relieved from liability, even though the minor was under the age fixed by statute. Of course, the question of whether an employer has exercised due caution will be one of fact. (194 N.Y. 92). In the light of the foregoing, it is not likely that an employer will be relieved from liability for the unlawful employment of a minor, if he relies upon the latter's statement alone that he is of proper age.

VERBAL PROMISES BY SALESMEN

S. P. C.—Under what circumstances is a firm liable for verbal promises and guarantees made by a salesman?

Answered by Leo T. Parker, Attorney at Law, Cincinnati, Ohio

A.—Buyers and sellers of machinery quite commonly become involved in legal controversy as a result of unauthorized verbal promises made by salesmen. This phase of the law was recently considered by a higher Court (161 N.E. 240). The facts of this case are that a buyer and a salesman signed a sales contract made on the selling firm's regular order forms. The salesman verbally promised the buyer that his employer would perform a certain service not specified in the written contract. He also stated that the buyer would be permitted to cancel the contract later, if he desired to do so.

The buyer refused to fulfill the terms of the written contract because the selling firm refused to fulfill the verbal promises made by the salesman. After considerable correspondence, the seller sued the buyer, who attempted to avoid liability by introducing testimony of the salesman's promises. However, the Court held the buyer liable on the contract, and explained that a selling firm is not responsible for a verbal promise made by a salesman, unless the buyer proves that the selling firm, prior to the transaction, had expressed willingness to be bound by its salesman's promises.

Also, a selling firm may be bound by verbal promises, or guarantees made by its salesman when either the buyer or the salesman informs the seller of such promises, and the latter notifies the buyer that the contract is accepted in consideration of these promises, or the seller proceeds to ship the merchandise knowing that the buyer has relied upon the salesman's verbal promises.

In other words, a salesman has implied legal authority only to solicit orders and submit them to his employer for approval and acceptance. The buyer cannot introduce testimony relative to a salesman's verbal guarantees or promises, unless it is shown that the seller was guilty of fraud or deceit with respect to these verbal statements.

Special Tools and Devices for Railway Shops

Equipment Employed in Locomotive Repair Shops, Selected by Railway Shop Superintendents and Foremen as Good Examples of Labor-saving Devices

RAILWAY SHOP AUXILIARY EQUIPMENT

By H. H. HENSON, Foreman Machine and Erecting Shop, Southern Railway Co.

The accompanying illustrations show some inexpensively constructed pieces of auxiliary equipment used in a railway repair shop. These devices quickly repaid their cost by the saving in labor, time, and materials that they effected. Fig. 1 shows a type of drill rack that is stationed near drilling machines to save the operators from making trips

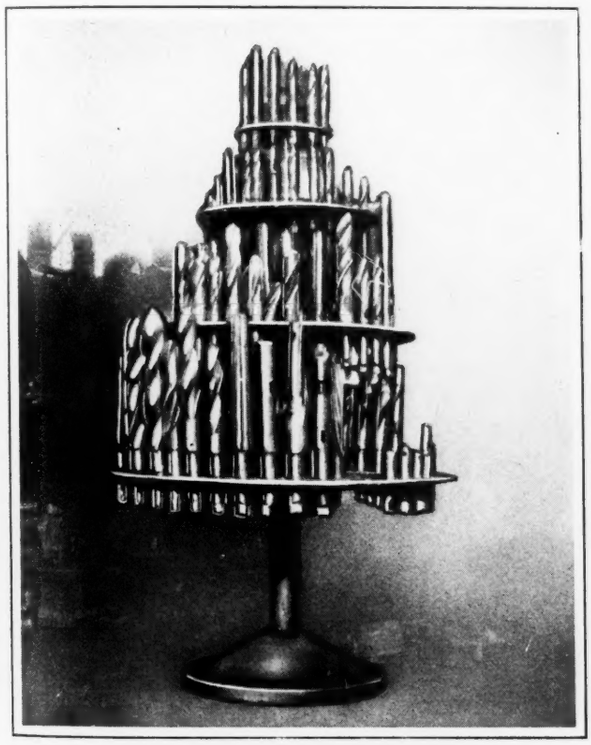


Fig. 1. Rack for Holding Drilling Machine Tools

to a distant tool-room. The racks are made of four disks of 3/8-inch boiler plate of about 12 3/8, 20, 29 1/2, and 40 1/2 inches diameter. These disks are spaced by four lengths of 3-inch gas pipe. Through the center of the disks and spacers is run a length of 3-inch steel pipe, which is screwed into a base 22 3/8 inches in diameter. The top disk is about 58 inches from the floor. The disks can be revolved to any desired position.

The ball-bearing adjustable stands shown in Fig. 2 are used for such work as holding the outer ends of long pieces level with the drilling machine table when it is required to do accurate drilling on such pieces. Their use for such work eliminates the need of a helper, and the adjustable feature saves much time that otherwise would be spent in looking for boxes and pieces of scrap to block the work up to the proper height. The smallest stand

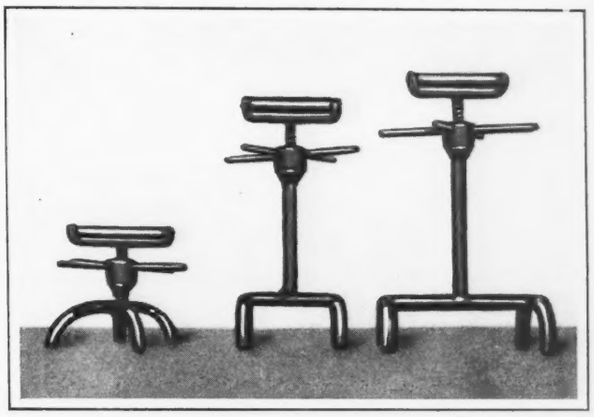


Fig. 2. Adjustable Stands with Ball-bearing Rollers

in the illustration has only three legs, and therefore stands more rigidly on an uneven flooring. The stands are constructed of 2-inch double-strength pipe. The screws are 1 1/2 inches in diameter with a 2-pitch Acme thread. The smallest stand is used in connection with a hydraulic rod bushing press. The other two stands illustrated are used for larger drilling machines.

A bar stock rack that can be quickly made from boiler plate with a cutting torch is shown in Fig. 3. Similar racks may be used for holding boring-bars and arbors, and are convenient when placed adjacent to turret lathes. The rack illustrated is made of 1/4-inch boiler plate. The three uprights are spaced by lengths of 1/2-inch pipe through which tie-bolts are passed. The slots in the uprights are 3 inches wide and 3 inches deep. The wall between the slots is 3 inches. The total height of the rack is about 48 inches.

Fig. 3. Bar Stock Rack Made of Boiler Plate and Pipe

Fig. 4. Scrap and Chip Wagon with Side Trap Doors and Hopper Bottom

Wagons of welded steel construction, like the one shown in Fig. 4, are used to collect brass, steel, and iron scrap or chips. They are distinctly marked for the kind of material they are to receive. They have side trap doors and hopper bottoms. When they are filled, they are drawn out of the shop by tractors, lifted by a crane, and the contents dumped into a car.

REAMING AND TAPPING MACHINE

By J. D. STEWART, Plant Engineer, Atlantic Coast Line Railroad Co.

The machine shown in the accompanying illustration is one of the greatest labor savers in our railway repair shop. It has a wide adaptability, and can be used for reaming and tapping holes of any diameter or length in any size or shape piece that can be gotten into the machine. It is particularly adapted for reaming knuckle-pin holes in side-rods, wrist-pin holes and piston fits in cross-heads, strap-bolt holes in main-rods, and for tapping wrist-pins. Jobs that formerly required two to five hours work for three or four men are now accomplished by one man with this machine in from five to ten minutes. The quality of the work is also much improved over the previous hand method of reaming and tapping. The illustration shows the general arrangement of the machine and its over-all dimensions. The machine, built largely from second-hand parts and scrap material, is mounted on two heavy blocks of timber, about 15 inches square.

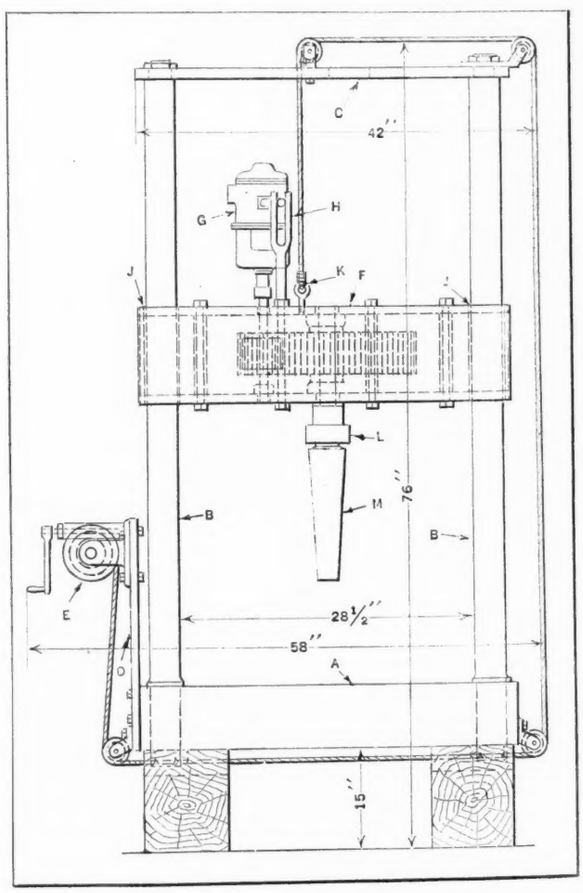
The machine consists of a faceplate *A* which was formerly used on a slotter; two 3 1/2-inch diameter vertical guide posts *B*, made from piston-rods; a 2- by 4 1/2-inch cross-brace *C* at the top; a bracket *D* for holding the windlass *E;* a movable frame or case *F* for holding the 5-horsepower air motor *G;* a fork *H* to prevent the motor from turning; and gears, chucks, etc. The guide posts *B* are bolted to the base. The cross-brace *C* holds the posts rigidly at the top, but is bent sufficiently to allow the motor *G* and fork *H* to pass so that the gear-case can be raised to the maximum height.

The gear-case *F* is made up of two 3/4-inch cover plates, lengths of 1 1/4-inch pipe for spacers between the plates, and 1-inch bolts passing through the plates and pipes to clamp the plates together. Brass bushings *J* pressed into the case are bored to have a sliding fit on the posts. A 1/2-inch cable is connected to the eyebolt *K* and passes over the sheave wheels to the windlass. By turning the crank on the windlass, the case is raised or lowered. A 3/4-inch eyebolt is screwed to the top of the case slightly off center so as to balance the unequal weight caused by the air motor. The sides of the case are covered with No. 16 gage sheet iron, attached with 1/4-inch machine screws.

The air motor is connected to the shaft on which is mounted a 4-inch diameter gear. This gear engages the 14-inch diameter main gear, which drives the chuck *L* and tool *M*. At full speed the motor runs at 42 revolutions per minute, and the tool at 12 revolutions per minute. The total weight of the case, chuck, motor, and other parts comprising the gear-case is about 750 pounds. This weight provides all the necessary vertical pressure on the tool.

* * *

During the past year slightly over 1000 miles of new railroads were constructed in the United States —the largest mileage for any year since 1916. In the meanwhile, 512 miles of railroad lines were abandoned. Texas ranked first among the states in the construction of new lines in 1928, with a total of 353 miles; Montana came second, and Illinois third.



Machine for Reaming and Tapping Locomotive Parts

How Carboloy Will Affect Tool Design*†

Changes Required in Construction of Machine Tools to Obtain Maximum Production with Tungsten Carbide Cutting Tools

By E. G. GILSON and G. N. SIEGER, Carboloy Co., New York

TUNGSTEN carbides are not a new discovery, but owing to their extreme brittleness, they have had, until recently, no commercial value as materials for cutting tools. The Osram Co., of Germany, manufacturer of incandescent lamps, originated new possibilities for tungsten carbide by adding other materials which made the resulting product a useful commercial article. The American patent rights representing the contribution of the Osram Co. to the art were assigned to the General Electric Co., and similar rights in these inventions for commercial exploitation, aside from the lamp industry, were assigned by the Osram Co. to the Krupp Co. of Germany.

Additional development work on the invention has been done by the Krupp Co. and also in the Research Laboratories of the General Electric Co. Negotiations between the Krupp and General Electric companies resulted in a contract whereby all American patent rights accrued to the General Electric Co. with the Krupp Co. retaining the right to export its product to the United States.

The Carboloy Co. was subsequently formed by the General Electric Co. with an exclusive license under all the General Electric Co.'s rights in cemented tungsten carbides. The Carboloy Co., in turn, granted sub-licenses to manufacture, use, and sell cemented tungsten-carbide tools to the Firth-Sterling Steel Co., McKeesport, Pa., and the Ludlum Steel Co., Watervliet, N. Y.

General Characteristics of Carboloy

Interest in Carboloy at the present time lies more especially in its use as a cutting tool, and the extent to which its unusual properties may affect machine shop practice or machine tool design. It has been applied to cutting a wide range of materials—non-metallic substances, such as fibers, hard rubbers, phenol compounds, carbon, and graphite; non-ferrous compounds, such as copper, brass, soft bronze, very tough bronze, copper tungsten, "elkonite," aluminum, and its alloys as used more especially in the automotive industry; and ferrous metals, such as cast iron, with its hard and sandy inclusions and hard scale, carbon steels, and many of the alloy steels.

In cutting the various materials enumerated, an outstanding characteristic is the ability of the tool to withstand many times the conventional cutting speeds now employed. In its nature, Carboloy is unlike those metals that are fused or cast, although in appearance it is very similar to steel, and a fracture of a broken piece has a marked resemblance to that of a piece of heat-treated high-carbon steel. The physical characteristics are, however, entirely dissimilar to those of steel. In fact, in respect to these properties, it is safer to consider the material more like the diamond or a piece of glass than a metal. It seems to have an entire lack of ductility. Its thermal expansion coefficient is low. Its heat conductivity is low. These, combined with its lack of ductility, cause it to be easily cracked or broken when subjected to rapid temperature changes or sharp temperature gradients.

Tungsten Carbide Tools Must be Firmly Supported

Emphasis has been laid on the brittleness and the tendency toward failure because of undue shocks. These weaknesses should not be underestimated. On the other hand, they should not be stressed to the point of not using tungsten carbide tools, because such tools have been applied successfully to various machining operations requiring considerable shock-resisting capacity. A firm support for these tools is, however, essential and the ordinary toolpost or tool clamp is a serious offender in this respect. As a matter of fact, cases have been encountered where it is necessary for best performance with cemented tungsten-carbide tools to remove the cross compound slide completely and build up directly from the tool carriage with a solid bolster and tool clamp.

Mention has been made of the lack of strength of Carboloy. Closer attention should be paid to this point, as it must be given serious consideration in the design of tools. Cemented tungsten carbide should never be used when it is not thoroughly supported by steel. The design of the tool should be such that when it is applied to the work the cutting strains are all transmitted through the Carboloy to the steel backing, and the application should be such that the Carboloy is under compressive strains only. Overhang of the material or an application that submits it to great shear should be absolutely avoided.

Trouble with Tailstock Centers Because of High Speeds

The ability of Carboloy to withstand high speeds and retain its cutting edge under high temperatures is well known. To obtain the most out of this material, therefore, stock should be removed by increasing the speed of cut rather than the cross-section of a chip.

In lathe work, where the tailstock center is used, either adequate means of lubricating the present type of dead center must be developed or a type

*Abstract of a paper read in Chicago before the joint meeting of the American Society of Mechanical Engineers and the Western Society of Engineers.

†Additional information on tungsten carbide tools will be found in the following articles previously published in MACHINERY, "The Grinding of Tungsten Carbide Steels," March, 1929, page 536; "Carboloy and Tungsten Carbide Tools," February, 1929, page 457; "What May be Expected from Carboloy," January, 1929, page 353.

of live center must be found to take its place. At present, no adequate way of lubricating the dead center has been discovered and no live center tested has been equal to the job. The most serious objection to the live center has been the chatter of the work. In using Carboloy tools on work that must be turned between centers, the problem of the tailstock center, while apparently of minor importance is really a serious one, and attention should be called to it.

At a recent exhibition of cutting with Carboloy tools, a piece of "hytensel" manganese bronze was brought in from the outside. The best previous record of cutting speed on this type of metal was 15 feet per minute. Using Carboloy tools, the maximum lathe speed and motor power were utilized, which meant that the material was cut at the rate of 460 feet per minute, with a depth of cut of 3/16 inch and a feed of 1/32 inch. The specimen was rapidly consumed at this rate of cutting, but the tool remained in the same condition as at the start. However, the tailstock center had lost its temper, and became badly scored. A little longer and the demonstration would have had to be interrupted on account of failure of the tailstock center. A lubricant could not be applied by ordinary means to keep this job running. This is just one of the many examples that can be quoted.

In many demonstrations it was possible to strengthen the tool-holder with fair ease, but the tailstock centers are a source of continual worry and require constant watching to avoid danger of accident and preserve continuity of operation.

Bearing Design and Lubrication

Naturally, high-speed operation—very much higher than present practice—brings into consideration other factors of machine tool design, an outstanding example of which is bearings. Since chatter and vibration are extremely detrimental, it is realized that this statement also holds for present-day tool practice, although these factors are not of the same importance as when cemented tungsten-carbide tools are employed. Many cases of chatter or vibration originate in the "head" of the machine, particularly in the bearings. This emphasizes the need for better bearings, both as regards design and lubrication. When operating at the increased speeds necessary for the most economical use of the cemented tungsten-carbide tools, lubrication of present-day machine tools is entirely inadequate. Many cases have developed in which the limitation was the lack of lubrication of the bearings of the machine being used. Better materials should be used in the bearings, better fits are necessary, and thorough lubrication must be assured. This means that it is practically necessary to redesign the power-transmitting members of the machine.

More Power Required—also Rigid Transmitting Members

More power must be transmitted to the cutting point of these new tools. A cemented tungsten-carbide tool is used because of its greater output per machine. Thus, more metal is removed per unit time, and this, in turn, increases power consumption. This increase, which may be as much as 100 per cent, obviously must be transmitted from the driving medium to the tool point. The power per unit of metal removed may be reduced, but more work is done per unit of time.

The rigidity of all power-transmitting members is of prime importance. Gears must be smooth running, well balanced, and of ample strength. Power application should be made close to rigid support members and never on a shaft midway between bearing supports. The design of power-transmitting shafts should be so ample that all torque vibration is eliminated. With due attention given to these details, together with properly designed and lubricated bearings, economic employment of Carboloy should be possible.

The Use of Coolants or Lubricants

The major experiences thus far with Carboloy cutting tools have been without the use of coolants or lubricants, although unquestionably their use should tend toward the same results and in the same ratio as in present-day practices. Coolants and lubrication have not been employed for the simple reason that the machines were not capable of utilizing the Carboloy tools to their maximum capacity, and therefore no attempt was made to complicate the problems by these additions. When data are being gathered for ultimate machine tool design, unquestionably coolants and lubricants will occupy an important place.

Types of Tools Now in Use

In turning work, practically every application has been to the single-point cutting tool in contradistinction to tools of the multiple-cutting-point type. At the present time, practically all efforts are concentrated on the production of tools for the lathe and boring mill. This does not mean that intensive work has not been done in other lines. As a matter of fact, work is under way now on practically every possible adaptation of Carboloy. Thus, it is being applied to drills, reamers, cutters, drawing dies, saws for metals, slates, marbles, and wood, and as a substitute for the diamond in rock drilling, oil-well work, etc. Promising results in all fields have been obtained.

For the first time Carboloy has been successfully employed in a blanking die. This is an application which from its very nature would not be expected to be successful. However, an experimental notching die was made for use with hard silicon steel, 15 mils thick. On this job the best previous performance with a steel die was 60,000 notchings. For a chromium-plated steel die 90,000 punchings was the extreme limit. The cemented-tungsten-carbide die up to the present time has given 130,000 punchings, the last as good as the first, free from burns and with perfectly smooth edges.

* * *

As a result of the steadily growing factor of safety in air transportation, fifty of the leading insurance companies of the United States and Canada are covering travel by air. It is now possible for any pilot or passenger to obtain a life policy up to a maximum indemnity of $50,000.

MILLING EXTREMELY NARROW SLOTS AROUND TEXTILE DRUMS

Knitting needles in certain types of knitting machines are guided by means of many narrow slots, accurately spaced around small drums or cylinders. These slots vary from 0.020 to 0.035 inch in width and from 1/8 to 1/2 inch in depth. Some builders of knitting machines produce the slots on milling machines, employing hand-operated index-centers, while others use the quicker automatic gear-cutting machines. With both types of machines, considerable difficulty has been experienced in milling the slots, because of the tendency of the cutter to widen the slots or bind and mar the drum when the cutter is returned to its starting position.

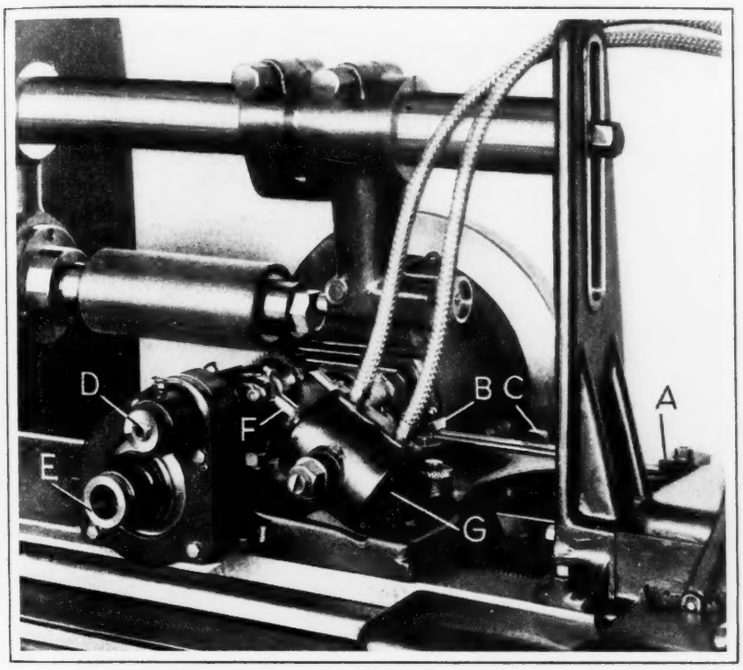


Fig. 1. Milling Extremely Narrow Slots around Knitting Machine Drums by Means of a Special Attachment Applied to a Gear-cutting Machine

To overcome this difficulty, an ingenious hydraulically operated device has been designed by the Brown & Sharpe Mfg. Co., Providence, R. I., for application to the No. 3 automatic gear-cutting machine for cutting straight slots, and to the No. 13 automatic gear-cutting machine for cutting bevel slots. Not only does the attachment give greater accuracy of the slots, but it also increases production rates.

A front view of the attachment is illustrated in Fig. 1, with the cutter in position to commence milling a slot. Fig. 2 shows the back of the machine, and illustrates the arrangement of the hydraulic valve control, etc. It will be noted from Fig. 1 that the slotting-cutter spindle *D* is mounted in a bracket that swivels about the center of spindle *E*, which is normally the gear-cutter spindle of the machine. This spindle *E* is mounted in the cutter-slide and driven in the usual manner. Within the bracket a large gear mounted on the gear-cutter spindle drives a pinion on the slotting-cutter spindle, thus increasing the speed of the latter (a feature which is especially advantageous) and also changing the direction of cutter rotation.

A hydraulically operated piston-rod *F* is connected to the upper part of the attachment in such a manner that when hydraulic pressure is applied, the slotting-cutter spindle is raised or lowered. A positive stop insures accurate cutting to depth when the spindle is raised into the cutting position. When the cutter-slide completes a forward movement, dog *A* engages lever *C* and operates the hydraulic valve *H*, Fig. 2. Oil then enters cylinder *G*, causing the piston to pull the slotting-cutter spindle down until the cutter is clear of the work before the cutter-slide is reversed automatically in the usual way. As the return travel of the slide is completed, dog *B* engages lever *C*, and operates valve *H* in the opposite direction, causing the oil in cylinder *G* to raise the slotting-cutter spindle into position against the positive stop, where it is held for the duration of the cut. In the meantime, the work is indexed in the usual manner.

The slotting cutter revolves clockwise and is fed forward across the work, which tends to prevent the thin cutter from producing crooked slots. Withdrawal of the cutter from the work before the return movements of the cutter-slide, results in some of the chips remaining in the slots, and this helps to support the thin walls when subsequent cuts are being taken.

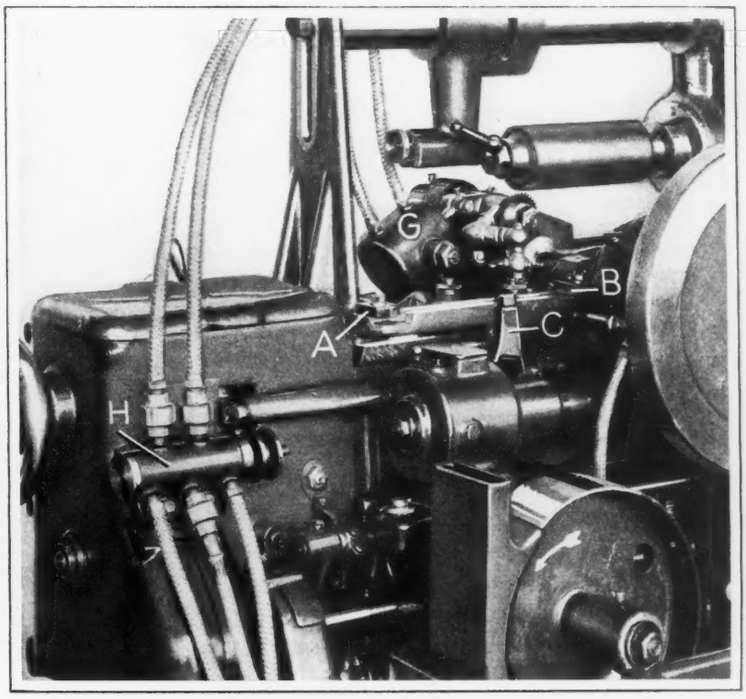


Fig. 2. Arrangement of the Hydraulic Control Provided on the Machine Shown in Fig. 1

Square Versus Round Wire for Helical Springs

Comparative Torsional Stress, Load, and Energy Storing Capacity of Springs of Round and Square Wire

By ELMER LATSHAW

HELICAL springs carrying compressive axial loads are usually made of wire of circular cross-section. If for some reason it is desired to use square-section wire, the following formulas will be found useful in working out the spring design. It will be noted that square-section wire is less efficient than circular-section wire. This fact should discourage the use of square wire unless there is some good reason for employing it which outweighs the lower spring efficiency. The symbols used in the formulas are:

W = axial spring loading;
d = diameter of round wire;
S = side of square wire;
D = pitch diameter of helix;
R = pitch radius of helix;
f = torsional fiber stress;
N = torsional modulus of elasticity;
l = active length of bar in spring;
E = energy stored in spring;
J = polar moment of inertia;
$= \pi d^4 \div 32$ for round wire;
$= 0.844S^4 \div 6$ for square wire;
Z = polar section modulus;
$= \pi d^3 \div 16$ for round wire;
$= 0.208S^3$ for square wire;
y = spring deflection; and
T = torsional moment on wire.

The values $J = 0.844S^4 \div 6$ and $Z = 0.208S^3$, for square bars are empirically derived, and are taken from A. Morley's "Strength of Materials," page 295. The torsional stress in helical springs is equal to the torsional moment $T = \frac{WD}{2}$ divided by the polar modulus of the wire Z; then, for round bars:

$$f = \frac{T}{Z} = \left(\frac{WD}{2}\right)\left(\frac{16}{\pi d^3}\right)$$

For square bars,

$$f = \frac{T}{Z} = \left(\frac{WD}{2}\right)\left(\frac{1}{0.208S^3}\right)$$

Transposing in these formulas gives the following capacity formulas:

For round bars:

$$W = 0.393f\left(\frac{d^3}{D}\right)$$

For square bars:

$$W = 0.416f\left(\frac{S^3}{D}\right)$$

The preceding formulas show that for equal stress, square wire will carry $0.416 \div 0.393 = 1.06$ times the load of round wire, assuming that $S = d$, that is, that the side of the square wire equals the diameter of the round wire, and the pitch diameter D is the same in both springs. However, the square wire is of greater area than the round wire, and if compared on the basis of load carried per unit volume of spring material, we have:

$$\frac{\text{Area of round}}{\text{Area of square}} \times 1.06 = 0.7854 \times 1.06 = 0.833$$

This formula shows that as far as capacity at a given stress is concerned, square wire is 83.3 per cent as efficient as round wire. The deflection formula for coil springs is:

$$y = \frac{WR^2l}{NJ}$$

Then, for round wire:

$$y = \left(\frac{f\pi d^3}{8D}\right)\left(\frac{R^2l}{N}\right)\left(\frac{32}{\pi d^4}\right) = \frac{flD}{Nd}$$

For square wire,

$$y = \left(\frac{0.416fS^3}{D}\right)\left(\frac{R^2l}{N}\right)\left(\frac{6}{0.844S^4}\right) = \left(\frac{flD}{NS}\right)(0.7393)$$

Again comparing springs where $S = d$ and the pitch diameter and stress are equal, the amount of deflection in the square wire is 73.93 per cent as great as in the round wire. Comparing the energy that can be stored in the two wires, we have:

$$E = \frac{Wy}{2} = \frac{1}{2}\left(\frac{f\pi d^3}{8D}\right)\left(\frac{flD}{Nd}\right) = 0.196\left(\frac{f^2ld^2}{N}\right)$$

for round wire, and for square wire we have,

$$E = \frac{Wy}{2} = \frac{1}{2}\left(\frac{0.416fS^3}{D}\right)\left(\frac{0.7393flD}{NS}\right) = 0.154\left(\frac{f^2lS^2}{N}\right)$$

Hence round wire will store $\frac{0.196}{0.154} = 1.273$ times as much energy as square wire, although the round wire has less area. If we express spring efficiency as energy stored per unit volume of spring material, the efficiency ratio will be,

$$\frac{\text{Area of square}}{\text{Area of round}} \times 1.273 = \frac{1.273}{0.7854} = 1.62$$

This shows round wire to be 62 per cent more efficient than square wire.

The above formulas for deflection and capacity were verified by comparing actual spring tests of square and round wire springs, and proved to be well within the desired range of accuracy. These formulas differ from those commonly found in print, but since they agree so well with the results of actual tests, it is felt that they may be of value.

MACHINERY'S DATA SHEETS 151 and 152

WEIGHTS OF CAST-IRON CYLINDERS, IN POUNDS PER FOOT OF LENGTH

Inside Diameter of Cylinder	Thickness of Metal, Inches											
	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾
2′–0″	90	120	150	181	213	245	....	....	....	....	....	....
2′–6″	112	149	187	226	264	303	....	....	For Cast Steel, Multiply			
3′–0″	134	179	224	270	316	362	409	....	Values in Table by 1.09			
3′–6″	156	208	261	314	367	421	475	....	....	....	....	....
4′–0″	178	238	298	358	419	480	541	....	....	....	....	....
4′–6″	200	267	334	402	470	539	607	676	....	....	....	....
5′–0″	...	297	371	446	522	598	674	750	....	....	....	....
5′–6″	...	326	408	490	573	656	740	823	....	....	....	....
6′–0″	...	356	445	534	625	715	806	897	989	....	....	....
6′–6″	...	385	482	578	677	774	873	971	1069	....	....	....
7′–0″	...	...	518	623	728	833	939	1045	1150	1257	....	....
7′–6″	...	...	555	667	780	892	1005	1118	1231	1345	....	....
8′–0″	...	...	592	711	831	950	1071	1192	1312	1433	1555	....
8′–6″	...	...	...	755	883	1009	1138	1265	1393	1521	1650	....
9′–0″	...	...	...	800	934	1068	1204	1339	1474	1609	1746	1882
9′–6″	...	...	...	844	988	1127	1270	1413	1555	1697	1842	1985
10′–0″	...	...	...	888	1037	1186	1336	1486	1636	1786	1937	2088
10′–6″	...	...	...	...	1088	1245	1403	1559	1717	1874	2032	2191
11′–0″	...	...	...	...	1139	1304	1469	1632	1798	1962	2128	2294
12′–0″	...	...	...	...	1242	1422	1602	1779	1960	2139	2320	2500
13′–0″	...	...	...	...	1345	1539	1734	1926	2122	2315	2512	2707
14′–0″	...	...	...	...	....	1656	1867	2073	2284	2492	2703	2911
15′–0″	...	...	...	...	....	1773	2000	2220	2446	2669	2894	3117

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MACHINERY'S Data Sheet No. 151, New Series, April, 1929

Contributed by Harold Ball

DIAMETERS AND TOLERANCES FOR HAND TAPS

Adopted by Tap and Die Manufacturers (Supersedes Data Sheet No. 49)*

Commercial Tolerances for Hand Taps, Pulley Taps, and Taps for Beaman & Smith Holders

U. S. Standard Screw Threads		Tap Measurements—Cut (Unground) Threads						
		Basic Screw Thread Diameters		Major (Outside) Diameter		Pitch Diameter		
Size and No. of Threads		Major (Outside) Diam.	Pitch Diam.	Minimum	Tolerance	Minimum	Maximum	Tolerance
1/4–20		0.2500	0.2175	0.2525	0.0025	0.2180	0.2200	0.0020
5/16–18		0.3125	0.2764	0.3155	0.0025	0.2769	0.2789	0.0020
3/8–16		0.3750	0.3344	0.3785	0.0025	0.3349	0.3369	0.0020
7/16–14		0.4375	0.3911	0.4410	0.0030	0.3916	0.3941	0.0025
1/2–13		0.5000	0.4500	0.5040	0.0030	0.4505	0.4530	0.0025
9/16–12		0.5625	0.5084	0.5670	0.0030	0.5089	0.5114	0.0025
5/8–11		0.6250	0.5660	0.6300	0.0030	0.5665	0.5690	0.0025
3/4–10		0.7500	0.6850	0.7550	0.0040	0.6855	0.6885	0.0030
7/8–9		0.8750	0.8028	0.8805	0.0040	0.8038	0.8068	0.0030
1–8		1.0000	0.9188	1.0060	0.0040	0.9198	0.9228	0.0030
1 1/8–7		1.1250	1.0322	1.1310	0.0045	1.0332	1.0367	0.0035
1 1/4–7		1.2500	1.1572	1.2565	0.0045	1.1582	1.1617	0.0035
1 3/8–6		1.3750	1.2668	1.3820	0.0045	1.2678	1.2713	0.0035
1 1/2–6		1.5000	1.3917	1.5075	0.0045	1.3927	1.3962	0.0035
1 5/8–5 1/2		1.6250	1.5069	1.6325	0.0055	1.5084	1.5124	0.0040
1 3/4–5		1.7500	1.6201	1.7575	0.0055	1.6216	1.6256	0.0040
1 7/8–5		1.8750	1.7451	1.8830	0.0055	1.7466	1.7506	0.0040
2–4 1/2		2.0000	1.8557	2.0085	0.0055	1.8572	1.8612	0.0040
2 1/8–4 1/2		2.1250	1.9807	2.1335	0.0060	1.9822	1.9867	0.0045
2 1/4–4 1/2		2.2500	2.1057	2.2590	0.0060	2.1072	2.1117	0.0045
2 3/8–4		2.3750	2.2126	2.3845	0.0060	2.2146	2.2191	0.0045
2 1/2–4		2.5000	2.3376	2.5100	0.0060	2.3396	2.3441	0.0045
2 5/8–4		2.6250	2.4626	2.6340	0.0070	2.4646	2.4696	0.0050
2 3/4–4		2.7500	2.5876	2.7600	0.0070	2.5896	2.5946	0.0050
2 7/8–3 1/2		2.8750	2.6894	2.8850	0.0070	2.6914	2.6964	0.0050
3–3 1/2		3.0000	2.8144	3.0105	0.0070	2.8164	2.8214	0.0050

A maximum lead error of plus or minus 0.003 inch in one inch of thread is permitted.

THREAD ANGLE TOLERANCES

Threads per Inch	Permissible Error in One Half Angle	Total Permissible Error in Full Angle
4 and less	Plus or Minus 30 Minutes	45 Minutes
1 1/2 to 5 1/2	Plus or Minus 35 Minutes	53 Minutes
6 to 9	Plus or Minus 40 Minutes	60 Minutes
10 to 20	Plus or Minus 45 Minutes	68 Minutes

*Larger outside diameters have been adopted to allow for greater wear, and the minimum pitch diameters on taps over ¾ inch have been increased to compensate for lead errors.

MACHINERY'S Data Sheet No. 152, New Series, April, 1929

FITTING AND CHECKING TAPER SHANKS

By FRITZ L. KELLER

Recently considerable thought has been given to the standardization of taper shanks. In most machine shops, the fitting of the taper shank of an arbor or other tool to a spindle is still accomplished by trying it in the spindle of the machine in which it is to be used. This is a very wasteful method. First of all, time is wasted in walking back and forth from the lathe or grinder to the machine in which the taper is being fitted. Second, production is interfered with, because the machine in which the taper is being fitted has to be stopped and, in many cases, it is necessary to remove the tool set-up.

This procedure is repeated each time a shank is to be fitted. By providing a proper taper plug and socket gage, this wasteful practice can be eliminated. The majority of machine tools are furnished with either a Morse or Brown & Sharpe taper for which standard plug and socket gages may be purchased. However, there are a good many other machines for which a special plug and socket gage must be made unless the tapers in the spindles can be rebored to a standard size.

In Figs. 1 and 2 are shown a taper plug gage and a taper socket gage, respectively, which may be used to advantage for fitting as well as for checking taper shanks. Both gages are made of tool steel, and are hardened and ground. The diameter *A* is made to equal the large diameter in the end of the taper in the spindle, and the dimension *B* equals the distance the shank should extend from the face or end of the spindle. These two dimensions, as indicated by *A* and *B*, should always be specified on a tool drawing, together with the amount of taper per inch or per foot and the limits or tolerance for dimension *B*, which should be plus or minus 1/32 inch, and the over-all dimension, as indicated in Fig. 3. The latter illustration is shown to indicate the proper method of dimensioning a taper shank.

The dimension *B* is given so that the tool designer will have some definite figure to work to when considering interference, and will be able to keep all shanks within such limits as may be established by the individual manufacturer. One-half of the end of the socket gage shown in Fig. 2 is cut away for a depth equal to dimension *C* to permit checking the fit of the taper shank by sight as well as by the use of testing or measuring instruments. The flat on the knurled section of the gage, Figs. 1 and 2, provides a surface on which the name and number of the machine with which the gage is to be used can be stamped. The amount of taper per inch or per foot should also be stamped in this space.

As an example, let us assume that a lathe having a No. 4 Morse taper must be rebored to measure 1.500 inches in diameter at the large end, with the same amount of taper per foot as a No. 4 Morse taper, which is 0.625 inch.

The first step is to rebore the taper in the spindle to a diameter of 1.500 inches at the large end. The taper plug gage can then be made to fit the newly bored taper in the spindle. When thus fitted, the large end of the taper plug gage should project from the face of the spindle the proper amount, as indicated by dimension *B*.

After the taper plug gage has been fitted in this manner, it is used in making a socket gage such as shown in Fig. 2, which must also be ground to measure 1.500 inches in diameter at the large end of the taper, as indicated by dimension *A*. The length of the socket gage should be the same as a regular No. 4 Morse taper, or 4 1/16 inches. In other words, the socket gage is a duplicate of the spindle, and the plug gage is a master shank, intended for fitting and checking purposes only. In checking a taper shank, it is only necessary to place the shank in the socket gage, hold a scale between the large end of the shank or the shoulder

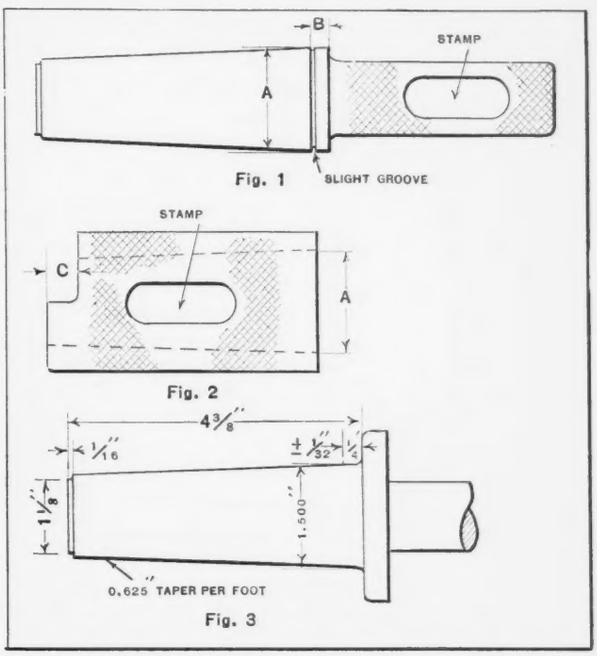


Fig. 1

Fig. 2

Fig. 3

Fig. 1. Taper Plug Gage. Fig. 2. Taper Socket Gage. Fig. 3. Properly Dimensioned Taper Shank

and the large end of the socket gage, and note that the distance *B* is within the limits specified on the tool drawing.

* * *

CARBON PASTE FACILITATES WELDING WHEN BROKEN PIECES ARE MISSING

When all the pieces of a broken part are saved, the job of welding them together is usually comparatively simple, but often the welding of a broken part is difficult because one or more pieces are lost. When pieces are missing, a filler core can be built up from a carbon paste marketed by the Oxweld Acetylene Co., 30 E. 42nd St., New York City, which will resist the heat of the welding flame and support the molten metal filled in.

After a break has been filled with the carbon paste, the paste is smoothed to shape with a putty knife, and it must be packed tightly so that the molten metal will stay where it is put. When cold, the carbon paste can be easily removed from holes. Internal surfaces of parts may be so well formed by means of the carbon paste that little or no finishing is necessary.

The British Metal-working Industries

From MACHINERY's Special Correspondent

March 16, 1929

THE most interesting feature of the situation in regard to heavy industries at the present time is the renewed activity in the coal mining areas. In many districts, the pits that have not been closed down during the long period of depression are now being operated to capacity, and according to some reports, more miners could be employed at some collieries than are available. It must not be assumed that the troubles of the coal mining industry are by any means over, and the present spurt can have but little effect on the unemployment situation as a whole, since, owing to closing of pits and the installation of modern machinery, there is now a large labor surplus which can never be reabsorbed in this industry. At the same time, the activity now prevailing is providing a much needed stimulus.

With the better conditions and brighter prospects now being experienced in many sections of the engineering industry, there is an increased demand for skilled men for the works, as well as for designers and draftsmen, and there is a prospect of a shortage of suitable men if trade continues to expand. The reason is to be found in the fact that large numbers of men have changed their occupation during recent years, while in many districts, parents are reluctant to allow their boys to serve an engineering apprenticeship.

Satisfactory Conditions Reported in the Machine Tool Industry

Generally machine tool makers remain well employed, and there is every indication that in most districts the satisfactory conditions that have prevailed in recent months will continue for some time to come. Reports from some individual firms indicate, however, that the volume of orders booked during the first two months of the present year fell off in comparison with those secured during the last two months of 1928.

In the Halifax district, drilling and boring machinery represents the most active line, the increased demand from the shipyards being largely responsible for the number of orders booked for machines of this class. Radial drilling machines are also selling well at present, while orders for grinding machines, lathes, milling machines, and gear-hobbing machines are, on the whole, satisfactory.

Overseas Trade in Machine Tools Increases

January proved to be an exceptionally good month for machine tool exports. The total tonnage exported was 1780, as compared with 1309 tons in December and 1382 tons in November, the former figure being nearly 50 per cent higher than the monthly average of 1928. The value of exports during January was £247,260 as compared with £162,813 in December and £165,214 in November, the former figure exceeding by more than 60 per cent the average monthly value of exports during 1928. Exports of tools and cutters during January were valued at £54,008, as compared with £52,195 in December and £55,499 in November.

Imports during January amounted to 847 tons, with a value of £136,838, as compared with 648 tons, valued at £117,982 in December, and 1090 tons, valued at £163,905 in November, 1928.

The United States and Germany were by far the largest individual exporters of machine tools to this country during 1928. Thus, Germany contributed 4129 tons, with a total value of £441,558, and the United States 3858 tons, with a total value of £858,720; in other words, Germany supplied nearly 47 per cent by weight and rather more than 31 per cent by value of the total imports, while the United States supplied nearly 44 per cent by weight, and slightly more than 61 per cent by value. The high ton value of imports was due entirely to the high value weight ratio of machine tools from America, the ton value of such machines being £223, as against £107 in the case of machines imported from Germany.

Iron and Steel Production Rises

The national production figures of iron and steel for January emphasize the progress that is being made, and with five additional blast furnaces brought into operation during the month, the February returns should reveal further improvement. Pig iron produced in Great Britain during January totaled 563,900 tons, compared with 540,400 tons in December, and an average of 550,900 tons for 1928.

The production of steel ingots and castings in January amounted to 761,600 tons, compared with 683,100 tons in December, and 626,200 tons a year ago. Though the January total was 1000 tons below the November figure, it is 50,000 tons higher than the average monthly production for 1928.

The Automobile Industry Fears Effect of Rise in Price of Gasoline

Considerable anxiety prevails at the present time in the automobile and allied industries owing to the recent increase in the price of gasoline. It is true that the advance of 2 1/2d per gallon to the consumer represents no very substantial sum, but in view of the fact that private cars and commercial vehicles are already heavily taxed, aside from the tax on gasoline, it is felt that any additional burden at present may retard the expansion of the industry considerably. The increase will probably be felt most by the large number of small road transport companies, passenger and freight charges having been cut to a very low figure in an effort to compete with the railway companies.

AIR-COOLED DIESEL AIRPLANE ENGINE

The possibilities and advantages of heavy-oil engines for aircraft use are presented in an article by L. M. Woolson, aeronautic and research engineer of the Packard Motor Car Co., in the February number of the *S. A. E. Journal.* Great interest is taken in this development, because it is known that the Packard company has been experimenting for some time with this type of engine and has successfully tested in the laboratory and in flight an experimental Diesel aircraft engine. According to Mr. Woolson, the engine weighs less than 3 pounds per horsepower developed, is capable of withstanding cylinder pressures in excess of 1200 pounds per square inch, and operates at compression ratios as high as 18 to 1 and at engine speeds from 1700 to 2000 revolutions per minute.

The greatest advantage claimed for this type of engine as compared with the gasoline engines now used universally for airplanes is its reliability. Comparing a nine-cylinder radial air-cooled engine of each type, the author shows that the heavy-oil engine, in which the fuel is pumped under high pressure directly into each cylinder in liquid form and is there spontaneously ignited by the heat of compression, is very much simpler than the gasoline engine. It has no carburetor and no electrical ignition system, as has the gasoline engine with its two independent sources of current.

In the Diesel engine, the ignition in each cylinder is independent of every other cylinder, and so is the fuel injection; hence the engine cannot be stopped by any trouble with the source of ignition or by dirt or water in the fuel supply system. If one cylinder fails to function, for any reason, the others continue, and the only effect is a reduction of power. For these reasons, Mr. Woolson believes that the oil engine is so reliable that when such engines become commercially available in large sizes, it will not be necessary to use more than one engine in large airplanes.

The second most important advantage is that virtually no fire risk exists with the Diesel engine, and consequently the danger to passengers and pilot in case of a crash is greatly diminished. No fire has occurred, states Mr. Woolson, in all the experimental work he has done.

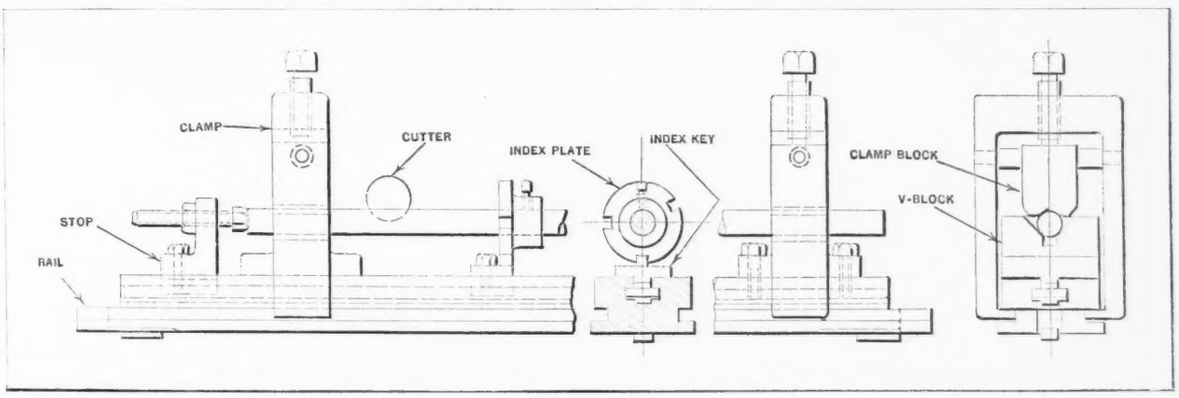
A third advantage is that the specific fuel consumption is about 20 per cent less than with the gasoline engine, and the fuel cost is reduced about 70 per cent. Moreover, open exhaust ports are permissible from the standpoints of both noise and night-flying vision; hence exhaust manifolds can be eliminated, reducing weight and drag. Temperature and humidity conditions do not affect the operation of the engine, interference with radio communication is eliminated, as there is no electrical system, and flexibility of control is assured at all times.

* * *

INDEXING AND SPACING FIXTURE

By FRED S. SAUNDERS

The fixture shown in the accompanying illustration, for use in spacing keyways in shafts, was developed by a company having a production of from 200 to 400 machines per year. Each machine contained from fifteen to eighteen control shafts, and each shaft had two and sometimes three keyways spaced at different angles around the shaft. The shafts were 7/8 inch, 1 1/2 inches, and 2 inches in diameter, and were from 12 to 60 inches long. It was impossible to use the dividing head for all the shafts when cutting the keyways, on account of the lengths, and it was desirable, in this case, that no centers be made in the ends of the shafts.



Fixture and Indexing Plate for Positioning Woodruff Keyways on Shafts of Various Lengths and Sizes

With V-blocks and clamps like those shown, it is possible to hold any of the shafts for milling the keyways. The stop gives the proper location for the Woodruff cutter, and the simple index-plate gives the proper angular settings. The index-plate is bored to fit the size shaft for which it is to be used, and is held in place by a flat-point set-screw.

By placing the index-plate on the shaft with its hub to the right, it is possible to cut a keyway in one end of a long shaft, lift the shaft out of the V-blocks, turn it end for end, and cut a second keyway at the required position without moving the milling machine table.

One of the desirable features of this fixture is that it can be changed to suit shafts of different lengths at no additional expense, and changes in spacing require only the cutting of a new slot in the index-plate and the placing of a pin in one of the slots of the old plate. By having an index-plate for each shaft, there is practically no danger of making a mistake in indexing. The cost of the indexing plates is from $1.50 to $2.50.

THE MACHINE TOOL CENSUS FOR 1927

According to data collected by the Department of Commerce at the biennial census of manufactures taken in 1928, the establishments engaged primarily in the manufacture of machine tools in 1927 reported products valued at $159,513,125, of which amount $136,745,605 represented machine tools (including parts and attachments) and $22,767,520 other products.

The total production of machine tools in 1925 was valued at $123,652,005, of which $120,041,179 represented establishments in the machine tool industry, and $3,610,826 establishments in other industries which made machine tools as secondary products. The value of such production outside the industry in 1927 has not been ascertained, but will be computed later.

Of the 355 establishments reporting for 1927, 89 were located in Ohio, 37 in Illinois, 33 in Connecticut, 32 in Michigan, 30 in Massachusetts, 28 in Pennsylvania, 25 in New York, 19 in Wisconsin, 12 in Indiana, 12 in New Jersey, 8 in Rhode Island, 6 in Missouri, 5 in California, 5 in Vermont, 4 in New Hampshire, and 10 in other states.

The average number of wage earners in the machine tool industry during 1927 was 35,269, as compared with 30,831 in 1925. The total amount of wages paid in 1927 was $52,365,692, and in 1925, $46,711,302. The cost of materials, including factory supplies, fuel, and power, was $46,114,849 in 1927, as against $43,826,151 in 1925. The value added by manufacture represented $113,398,276 in 1927, as compared with $100,376,332 in 1925.

The 1927 Census of Manufactures gives the number of establishments engaged primarily in the manufacture of metal-working machinery, other than machine tools, as 62, with a product valued at $31,748,667. The different classes of machines are valued as follows: Rod and wire-working machinery, $679,588; rolling mill machinery, $7,774,325; sheet-metal working machinery, $15,673,062; wire drawing machinery, $488,431; all other metal-working machinery, $4,954,056.

Production of Machine Tools in 1927 and 1925

Kind of Machines	1927		1925	
	Number	Value	Number	Value
Bending machines	438	$368,643	807	$641,711
Boring machines				
Horizontal	255	1,412,224	583	1,687,889
Vertical	397	1,759,964	219	1,344,137
Broaching machines	255	371,827	435	540,093
Cutting-off machines:				
Rotary-cutter type	135	261,687	250	294,168
Hacksaw type	2027	352,456	1536	202,369
Drilling machines (except portable):				
Multiple-spindle	1078	3,281,236	1211	2,109,738
Radial	552	1,695,437	831	2,039,834
Sensitive	3691	1,746,921	3577	1,776,238
Vertical (upright)	1795	1,516,814	2529	1,119,883
Forging machines:				
Bolt, nut, and rivet	663	1,829,707	*	*
Bulldozers and other	51	584,131	67	559,510
Gear-cutting machines:				
Generator, hobbing type	703	2,237,822	647	2,025,735
Disk-cutter type, and other	230	626,664	*	*
Grinding machines:				
Cylindrical, plain	1007	2,926,404	*	3,136,075
Cylindrical, universal	408	715,070	330	508,500
Surface	934	1,695,111	894	1,466,760
Internal	932	2,893,307	765	2,005,278
Cutter, tool and knife	1535	746,564	*	3,617,277
Other	*	4,301,124	*	
Hammers (stationary):				
Drop	152	196,649	201	407,608
Steam or air, power (belt- or motor-driven), and other	283	340,648	654	421,854
Lathes:				
Engine	6700	7,131,632	5165	7,675,897
Bench	1050	215,535	930	397,627
Turret (and hand screw machines)	1631	4,176,823	1567	4,155,054
Other	1525	6,399,473	*	4,115,996
Planers	235	1,852,396	193	1,104,786
Milling machines:				
Hand feed	244	73,757	450	207,855
Power feed				
Plain	941	2,216,272	723	1,624,617
Universal	713	1,675,165	599	1,360,884
Vertical	488	1,597,826	*	*
Lincoln type	421	1,063,713	374	679,101
Planer type, and others	930	2,879,842	*	1,756,059
Pipe-cutting and threading machines	2281	1,344,145	2637	1,304,858
Portable tools:				
Drills, electric				
Reported by number	79,148	3,054,801	92,558	4,097,152
Not reported by number	.....	430,933	.....	.....
Drills, pneumatic	11,627	1,108,839	.....	.....
Hammers, pneumatic (chipping, riveting, calking, etc.)	30,513	3,467,486	53,104	6,049,773
Grinders, electric				
Reported by number	22,136	1,346,540	18,500	1,122,167
Not reported by number	.....	107,733	.....	.....
Other types and those distributed as to class	*	4,291,453	*	627,233
Presses:				
Hydraulic				
Bending and forming, and forging	389	1,895,692	1053	1,673,322
Power, for sheet-metal work	5199	5,625,880	*	6,321,631
Punching machines (stationary)	597	858,102	1034	1,910,160
Riveting machines (stationary)	1336	664,307	*	687,519
Screw machines (automatic):				
Multiple-spindle	825	3,321,503	1140	3,971,721
Single-spindle	985	1,887,199	1161	1,947,545
Shapers	986	1,628,775	1125	1,614,760
Shears (power)	1771	1,308,169	1892	1,351,204
Slotters	32	199,154	62	404,968
Threading machines (except for pipe):				
Die type	538	546,209	*	*
Milling type	113	482,177	81	344,106
Tapping machines	484	584,730	336	324,287
All other machine tools	....	5,880,105	....	5,240,832
Machine tools not distributed by classes shown above. No comparable data	....	.....	....	3,483,632
Parts and attachments		35,568,829	....	32,192,602
Machine tools, including parts and attachments, total value	....	†	....	$123,652,005
Made in the Machine Tool Industry	....	$136,745,605	....	$120,041,179
Made as secondary products in other industries	....	†	....	3,610,826

*Data incomplete.

†The value of machine tools made as secondary products by establishments engaged primarily in other lines of manufacture in 1927 has not yet been calculated, and therefore the aggregate value of machine tools produced in 1927 cannot be given.

Tungsten Carbide Tools for Production Work

Results Obtained With the New Tungsten Carbide Cutting Materials on Production Work in Several Automobile Plants

DURING the past month MACHINERY has collected from a number of leading automobile and machine building plants throughout the country information relating to the results obtained with various types of tungsten carbide tools now on the market, such as Carboloy and Widia metal. Information on the grinding of tungsten carbide tools, supplementing that which has been published in previous numbers of MACHINERY, has been obtained from the Abrasive Co., Philadelphia, Pa. All this data has been brought together in the present article, which gives the results of the latest experiments conducted with these new cutting tools. A great deal of material relating to this subject has also been placed at the disposal of the mechanical world through the paper that was read by E. G. Gilson and G. N. Sieger of the Carboloy Co. at the Machine Shop Practice Division meeting of the American Society of Mechanical Engineers held in Chicago on March 18. An abstract of this paper is published in this number of MACHINERY, beginning on page 613.

One of the most remarkable, not to say startling, results observed in actual production work with tungsten carbide tools, was obtained in drilling brass bushings made from hard rolled stock. The tools formerly used for this work were reground every two hours and had to be replaced after drilling about 600 pieces. Drills of the same general construction, with tungsten carbide inserts at the cutting lips, averaged about 175 hours between grindings and produced 50,000 pieces. The cost of the tungsten carbide inserted cutting-edge tool was about ten times that of the tool formerly used.

Drilling Hard-rolled Brass Bushings

In one of the large automobile plants, brass bushings made from hard-rolled flat brass stock, rolled to shape, are drilled with a four-lip drill provided with tungsten carbide inserts. This drill replaces a high-speed steel drill of the same design. The hole is 7/8 inch in diameter; the material is extremely difficult to machine, and in the past, a 10 per cent spoilage was not considered excessive. The tools formerly used lasted about two hours between grindings, producing about forty-five pieces per hour.

When tungsten carbide tools were substituted for the tools formerly used, no change was made in the procedure, and the same surface speed per revolution and the same depth of cut were employed. The speed was 750 revolutions per minute, the feed 0.018 inch per revolution, and the depth of cut, approximately 0.016 inch.

The drill with tungsten carbide inserts has averaged 175 hours between grindings, with practically no spoilage of the material being drilled; and in one instance, the tool was used for 222 hours before being reground. The tools formerly used had to be entirely replaced after about 600 pieces had been drilled. The tungsten carbide tool has produced 50,000 pieces, and it has been adopted as a regular production tool on this work in the shop referred to.

The cost of the tungsten carbide tool is approximately ten times as great as that of the high-speed steel tool previously used, but the saving in the grinding time and in the time that the machine would be idle while the tools formerly used were ground, together with the remarkable lasting qualities of the new tools, make them a profitable investment on this work.

Facing Bronze Castings and Turning Cast Iron

In the same shop, bronze castings are being faced with tungsten carbide tools at the rate of 4000 castings between grinds, as compared with 75 castings between grinds with the tools formerly used. The same speed and feed as formerly employed are used, because in this particular instance, the work is done in a machine with multiple tooling, and tungsten carbide tools are not suitable for the other operations performed in the machine. Hence, the speed must be adjusted to suit the regular cutting tools. In some instances, the machine tools used would permit of a higher speed, while in others the speed that would be most suitable for tungsten carbide tools is not available.

Cast iron is being machined in one automobile shop at the same speeds and feeds as formerly employed, the surface speed being 160 feet per minute, and the depth of cut 1/16 inch, with a feed of about 0.016 inch per revolution. The tools formerly used had to be reground for every 150 to 175 pieces. The tungsten carbide tools are reground, on an average, for every 2000 pieces; and in one instance, 4175 pieces were turned without regrinding.

In another instance, transmission cases made of hard cast iron are being turned with the same speeds and feeds as were formerly used. In the past, the tools were ground, on an average, after every 40 transmission cases had been machined. Tungsten carbide tools were substituted, and when the information here given was recorded, 725 transmission cases had been machined and the tools were still in good condition; in fact, no marks indicating wear could be seen on them.

Turning Aluminum Pistons

In another shop, the turning of aluminum pistons required regrinding of the tools formerly used every forty-five to sixty minutes. One tungsten carbide tool ran for eighty-one hours before it needed to be honed in position in the machine, and another tool in use when this information was recorded had been in action for fifty-four hours without having been honed. In another instance, 20 pistons per grind were obtained with the tools

formerly used, but 4000 pistons have been turned with a tungsten carbide tool without grinding or honing, and the tool is still in good condition.

It was found, however, that the tungsten carbide tool was not suitable for a grooving tool, nor did it give good results on cutting-off operations.

Tungsten Carbide Tools Replace Diamonds for Diamond Boring

In a well-known automobile plant, the babbitted end of the connecting-rod has been bored by means of diamond tools. The diamond tool, however, has recently been replaced by a tungsten carbide tool. The same speed and feed are being used as for diamond boring; the advantage of the new tool is due to the fact that the new tool material is cheaper than diamond tools, a saving of at least 50 per cent and possibly more having resulted. The lapping expense is much less than on diamond tools.

In the same shop, a cast-iron camshaft bearing was formerly diamond-bored. The diameter of the hole is 1 1/8 inch. The diamond tools have been replaced by tungsten carbide tools, with a saving on 4500 pieces of $200 for lapping expense on the diamond alone. The diamond tools had to be relapped for every 200 pieces. When the present data was recorded, the tungsten carbide tool had finished 4500 pieces and was still in good condition.

In diamond-boring bronze bushings, this company has not had the same success as in the two examples recorded in the foregoing. On bronze bushings of the quality used in this shop, the tungsten carbide tools do not seem to give as good results as the diamond tools.

The Grinding of Tungsten Carbide Tools

Because of the difficulties that have been experienced in grinding the various tungsten carbide tools recently placed on the market, the Abrasive Co., Philadelphia, Pa., has made some researches with a view to determining the best methods for grinding worn tools of the tungsten carbide type, such as Widia, Carboloy, and others. The research has been especially concentrated on the regrinding of the tools to renew the cutting edge.

The hardness of the new material is almost comparable to that of precious stones. The renewing of the cutting edge with the grinding wheel, therefore, is really a lapping operation, calling for a fine, soft wheel in preference to a coarse, hard wheel. On tools of special shapes, consisting of an edge of the tungsten carbide material brazed to steel, the grinding wheel used must not only grind the tungsten carbide tool, but also a large surface of the supporting steel body. Engineers of the Abrasive Co. recommend for this work a Borolon SB-46-J wheel. When tools made entirely from the tungsten carbide material—and especially those made from Carboloy—are to be ground, successful results have been obtained by using Electrolon 46-JE and 46-IE wheels. For very small tools, an Electrolon 60-IE wheel is suggested.

It is important to keep in mind that only light pressures should be used and the grinding operation should be done dry. In order to prevent grooving the wheel, the tool should be kept moving throughout the operation.

THE WORLD'S LARGEST AIRSHIP

It is very likely that the British airship R-100 will fly to the United States on her maiden trip during the coming month. This is the largest airship ever built. The first rigid lighter-than-air craft was launched by Count Zeppelin in Germany about twenty-eight years ago. Since that time more than 150 such airships have been built.

It may be of interest to compare England's latest contribution to lighter-than-air navigation with the *Graf Zeppelin*, the German airship which last fall made a successful trans-Atlantic round trip. The *Graf Zeppelin* is 776 feet in length, while the new British ship is only 709 feet long, but the gas capacity of the new British ship is 5,000,000 cubic feet, as compared with 3,750,000 cubic feet of the German ship. The increase in gas capacity is due to the difference in diameter, the *Graf Zeppelin* being 100 feet in diameter while the new British ship is 133 feet in diameter.

It is estimated that the British R-100 can carry 100 passengers, together with a crew of 40, and yet have space for 10 tons of freight or mail. This is a much greater passenger carrying capacity than that of the German ship. Within the hull are dining rooms, lounge, smoking room, cabins, and promenade deck, which rival in spaciousness and appointments those on an ocean liner. The R-100 is provided with six Rolls-Royce Condor 700-horsepower motors, and has a cruising radius of between 4000 and 5000 miles at a speed of 80 miles an hour. This is by far the largest amount of power and speed ever applied to an airship.

Of particular interest is the unique method of brazing the enormous body of the new British airship. This is accomplished by means of preformed wire rope stretched from point to point within the hull. The reason for using wire ropes is that they possess the adequate strength, with greatly reduced weight and vastly increased flexibility, as compared with the rods previously used. According to the American Cable Co., which has supplied the wire rope and fittings, more than 22 miles of "Tru-Lay" wire rope are used in the hull of the airship, and more than 9000 "Tru-Loc" fittings.

After the R-100 makes its demonstration flight across the Atlantic to the United States in April or May, it will be put into regular scheduled service between London, Egypt, and India. The cost of an airship of this kind is approximately $2,500,000. It hardly seems possible that the earning power of the ship could justify this expenditure, but a great advance in aircraft engineering has been made.

* * *

ELECTRIC HOIST MANUFACTURERS ELECT OFFICERS

At the annual meeting of the Electric Hoist Manufacturers Association held in New York, March 14, H. W. Standart, of the Northern Engineering Works, Detroit, Mich., was elected chairman of the association; and J. G. Worker, of the American Engineering Co., Philadelphia, Pa., vice-chairman. The next meeting of the association, which has headquarters at 165 Broadway, New York City, is scheduled to be held in New York, May 16.

New Machinery and Shop Equipment

A Complete Monthly Record of New Metal-working Machinery, Tools, and Devices for Increasing Manufacturing Efficiency and Reducing Costs

JONES ALUMINUM-INGOT FACING MACHINE

Aluminum billets or ingots are "scalped" on each side before the rolling process is started. This "scalping" or facing operation is performed to eliminate scale, obtain smooth surfaces, and determine whether the billet is free from defects. The faced surfaces must be especially smooth and free from scratches, gouges, or tool marks, as such marks show up plainly in the rolling process and ruin the surface of the extremely thin finished plate.

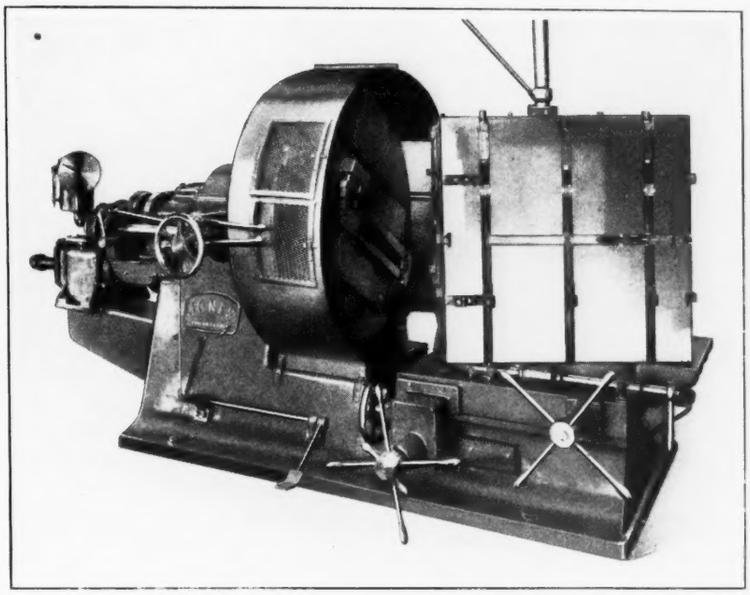


Fig. 1. Jones Facing Machine for "Scalping" the Sides of Ingots or Billets

A machine that has recently been developed by the Jones Machine Tool Works, Inc., 5300 Lansdowne Ave., Philadelphia, Pa., for facing aluminum ingots in the manner described in the foregoing, is shown in Figs. 1 and 2. To eliminate tool marks or scratches on the surfaces faced, this machine employs a single cutting tool which is fed from the periphery of a large-diameter cutter-head toward the center. In designing this machine, one of the most important problems was to provide for a fast fixed cutting speed at all diameters of the work, as the cutting speed must not increase or decrease with changes in the position of the tool as it moves toward the center of the cutter-head and work.

This fixed cutting speed is maintained throughout each operation by the use of a Waterbury oil-gear unit, which automatically increases the rotating speed of the cutter-head as the tool approaches its center. To permit operating the machine at the high speed required for facing operations on aluminum, the cutter-head is mounted on a large-diameter spindle, which is fully equipped with Timken tapered roller bearings.

The aluminum ingots to be "scalped" or faced, are mounted on the four-sided turret of the machine, which is hand-indexed and equipped with a quick-action locking and clamping device. Adjustable stops and clamps for billets of various sizes are furnished on the four sides of the turret. By loading all four sides, the operator can keep the machine in almost continuous operation, presenting each side of the turret in turn toward the cutter-head to bring successive ingots in line with the cutting tool.

Fig. 1 shows the operating side of the machine with its centralized control, the cutter-head with its safety cover, and the indexing turret fixture. Fig. 2 shows the driving side of the equipment with the Waterbury oil-gear unit in place.

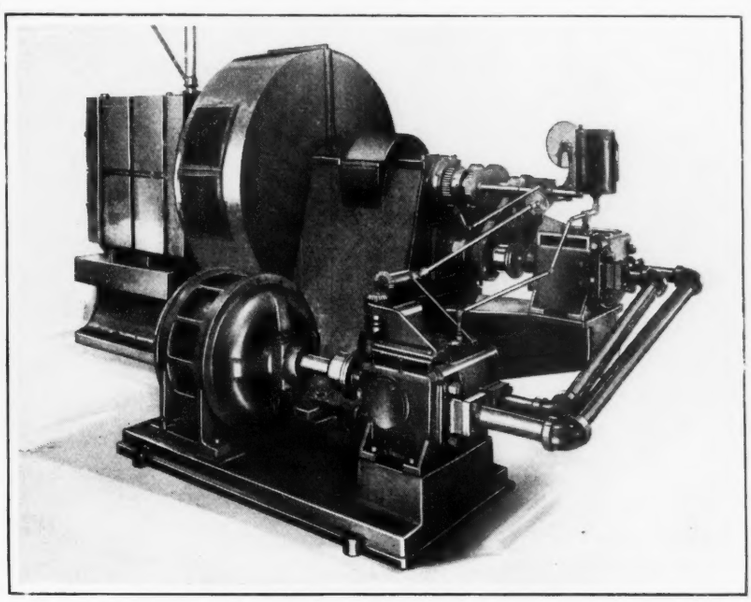
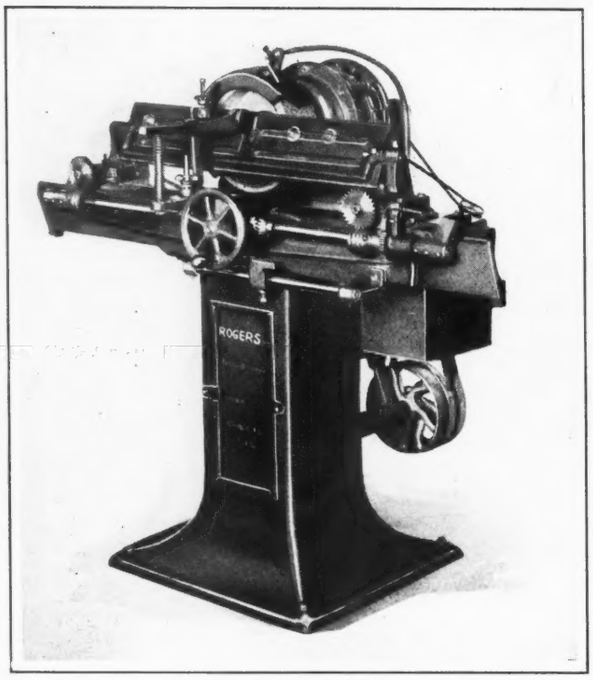


Fig. 2. Driving Side of Machine Showing the Waterbury Oil-gear Unit

In addition to aluminum ingots, machines of this type may be employed for facing billets of copper, monel metal, and similar materials. It is stated that the finish obtained on aluminum with this machine is comparable to that of plate glass.



Rogers Grinding Machine for Grinding Knives Against or Away from the Cutting Edge

ROGERS REVERSIBLE KNIFE-GRINDING MACHINE

A full-automatic cup-wheel grinding machine, designed for grinding knives either against the cutting edge (edge up) or away from the cutting edge, has just been placed on the market by Samuel C. Rogers & Co., 199 Dutton Ave., Buffalo, N. Y. This type W grinder has three longitudinal bearings to insure freedom from vibration and true knife edges. The back bearing is a particular feature, and is provided with an adjustable steel gib 1 inch wide, for taking up possible wear.

The Rogers spring cross-feed, which prevents overheating of knives, is furnished on this machine. Both longitudinal and cross feeding are fully automatic, positive-acting worms and gears being employed to stop the feeding at any desired point. In grinding knives with the cutting edge up, the delicate edge is always in plain view of the operator. It is claimed that the heat generated by the contact of the grinding wheel with the knife is directed or carried toward the body of the knife away from the delicate edge.

The travel of the table is at the rate of about 40 feet per minute, and is adjustable to suit the length of knife being ground. Supports are furnished for both ends of the bed on machines of the 44- and 54-inch sizes. These machines are also made in three smaller sizes, of 26, 32, and 38 inches. All sizes are equipped with a large 10-inch cup-wheel which has a surface speed of about 3300 feet per minute. The arbor may be mounted in ball or sleeve bearings. A one-horsepower built-in motor drives the machine. An index gages the degree of bevel on knives.

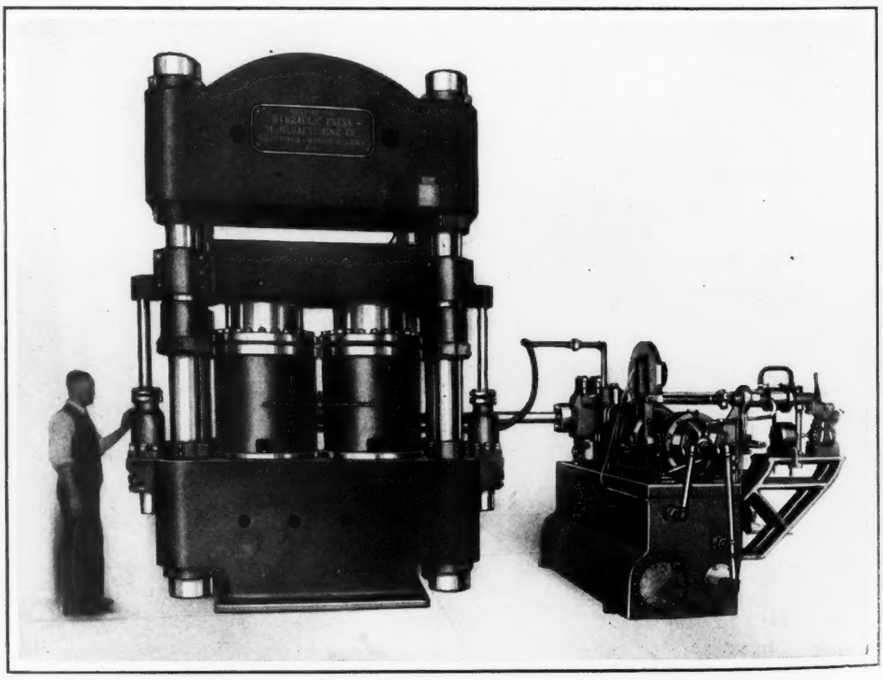
HYDRAULIC EMBOSSING PRESS WITH AUTOMATIC CONTROL

An automatic control recently developed and patented by the Hydraulic Press Mfg. Co., 20 E. Broad St., Columbus, Ohio, gives hydraulic presses the advantages of automatic pressure regulation, adjustable working pressure, variable stroke, adjustable opening, variable timing of the operating cycle, close speed regulation, and speed of operation. Although the illustration shows the application of this automatic control to a new embossing press, it can also be applied to hydraulic presses of a large variety of sizes and types.

The press illustrated has a pressure capacity of 1000 tons and operates at the speed of a mechanical press. It is double-acting, the working pressure being applied on the upward stroke. Two auxiliary pressure cylinders return the ram to its lower position.

Once set in motion, the press automatically performs and repeats the operating cycle, which involves closing at a rapid rate; shifting automatically to a slower pressing speed; building up pressure on the work to a predetermined maximum; holding this pressure until the termination of a definite time limit; releasing the pressure; opening at a rapid rate to the starting position; and reversing.

The hydraulic power required to operate this press is furnished by the H-P-M hydro-power generator shown at the right. This generator is of a two-stage type and has a direct electric motor drive. The automatic controls are incorporated in the gen-



Hydraulic Embossing Press Operated by Hydro-power Generator with Automatic Control

erator, there being no valves on the press. Two pipe lines form the only connection between the press and the generator. The company plans to build this type of press in a range of standard capacities from 250 tons upward.

POLLARD BARREL OR DRUM STAND

An all-steel stand intended for holding barrels of oil or other liquids, and enabling them to be easily transported about the shop, has recently been placed on the market by the Pollard Bros. Mfg. Co., Inc., 4034-36 N. Tripp Ave., Chicago, Ill. This stand is of such a height that a 5-gallon pail can be placed under the tap through which the oil or other liquid is withdrawn. The stand is constructed of structural steel members, arc-welded and riveted together, and is mounted on 3-inch casters. The barrel or drum rests on 2-inch casters, and can be easily rotated on the stand.

GLEASON 60-INCH HYPOID-GEAR GENERATING EQUIPMENT

Equipment for cutting large hypoid gears is a recent development of the Gleason Works, 1000 University Ave., Rochester, N. Y. This equipment consists of a large generating machine, designed for cutting spiral-bevel gears, to which is added a special work-head for cutting hypoid pinions. Besides the usual adjustments of the spiral-bevel gear head, this hypoid head has two other adjustments. The work-spindle can be offset vertically above or below center, so that the pinion can be cut in the same relative position in the machine as the position in which it is to be run with its mating gear. There is also a small horizontal transverse adjustment of the head.

The hypoid head can be used not only for cutting hypoid pinions, but also for cutting spiral-bevel pinions and gears of small pitch diameter. The approximate maximum dimensions of gears that can be cut with this hypoid equipment are as follows: Pitch diameter, 60 inches; cone distance, 30 inches; and face width, 8 inches. Teeth up to 1 1/2 diametral pitch can be produced. Spiral angles may range from 0 to 25 degrees. Gears can be cut with ratios between 1 to 1 and 1 to 10. The maximum vertical offset is 10 inches.

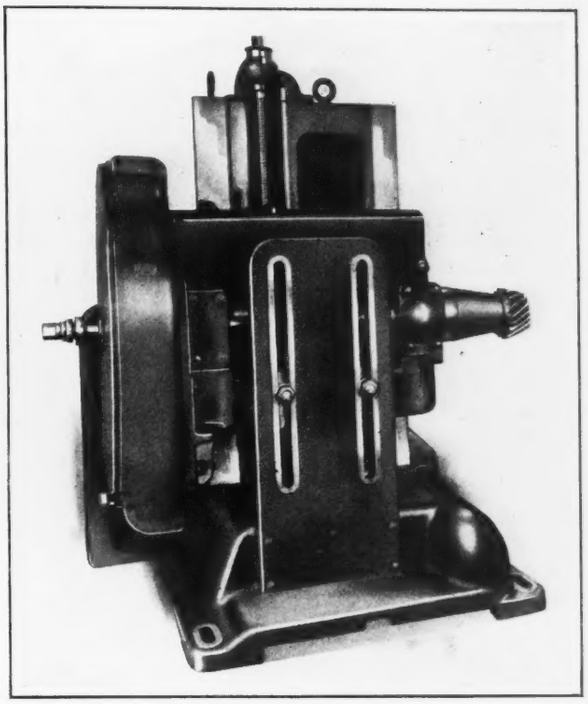


Fig. 2. Work-head with Spindle that can be Offset Vertically for Cutting Hypoid Pinions

Two important advantages are mentioned by the builder of this equipment for hypoid gears. First, the small amount of lengthwise sliding of the teeth introduced by the offset tends to make these gears even smoother running than spiral-bevel gears. Second, the offset between the axes of the gears makes it possible for both the gear and pinion shafts to continue past each other.

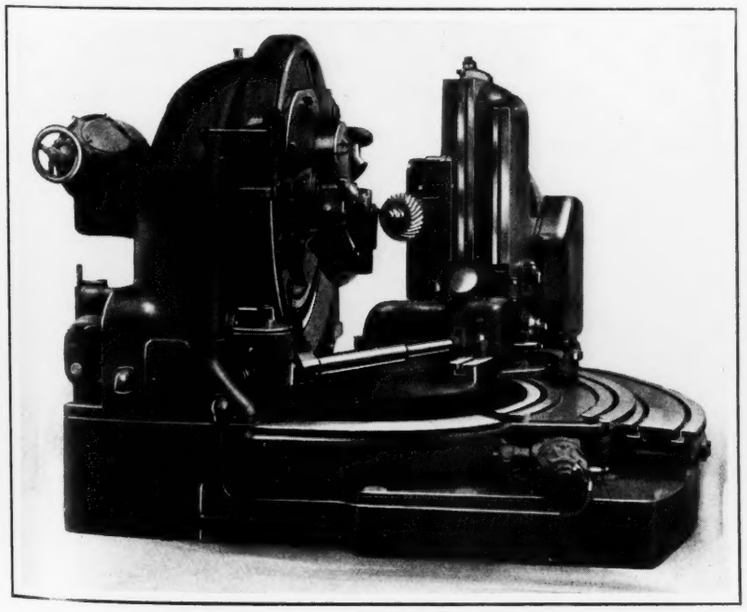


Fig. 1. Gleason 60-inch Generator Arranged for Cutting Hypoid Gears

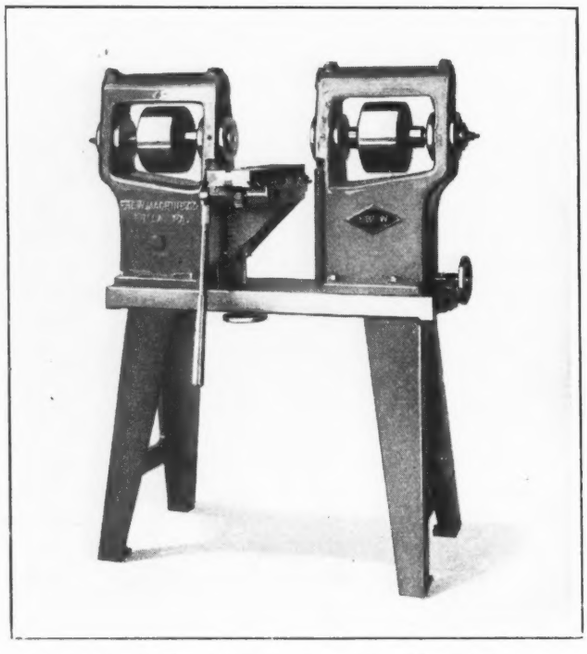
FREW DUPLEX HAND MILLER

A No. 2 duplex hand-feed milling machine designed to simultaneously mill parallel faces on small standard articles, such as hardware specialties, brass goods, parts for typewriters and cash registers, etc., is a recent addition to the line of the Frew Machine Co., 132 W. Venango St., Philadelphia, Pa. The machine consists essentially of two columns mounted on a bed, one column being stationary and the other movable. The stationary column carries a knee, saddle, and table.

Transverse movements of the table past the cutters are accomplished by means of a hand-lever which actuates a gear meshing with a rack on the bottom of the table. In and out movements of the table are effected by turning a screw by means of a wrench. Vertical movements of the

knee on the machine illustrated are accomplished by revolving the handwheel underneath the bed, but the machine can also be furnished with a lever feed for moving the knee through the action of a rack and pinion. The movable column is adjusted along the bed by turning the handwheel at the right-hand end of the machine. Bolts are provided for locking this column in the desired positions.

As illustrated, the machine is arranged for a single-pulley drive, but cone pulleys can be furnished. If desired, the fixed column can be bored at the top to receive an overload arm in cases where only one cutter is to be used and it is desirable to support it on both sides. Some of the principal specifications of this machine are as follows: Dimensions of table, 16 3/4 by 4 5/8 inches; maximum distance from center of spindle to top of table, 5 1/4 inches;



Frew Hand Miller for Simultaneously Milling Opposite Sides of Small Parts

maximum movement of table with hand-lever, 4 inches; and maximum and minimum distances between spindle ends, 10 and 6 3/8 inches, respectively.

BROWN & SHARPE GRINDING MACHINE AND WHEEL-TRUING ATTACHMENT

Recent additions to the line of machine tools and equipment built by the Brown & Sharpe Mfg. Co., Providence, R. I., include a motor-driven No. 1 universal grinding machine and a radius and angular wheel-truing attachment for application to No. 2 surface grinding machines. The new grinding machine is similar in design to the belt-driven machine of the same type, except that it is equipped with three constant-speed balanced motors, as illustrated in Fig. 1.

One of the important features of this machine is that the wheel-stand motor is reversible for use with the internal grinding attachment. Hence, in such operations, it is not necessary to swivel the wheel-stand platen into a reverse position. The motor is reversed by operating a lever. The three

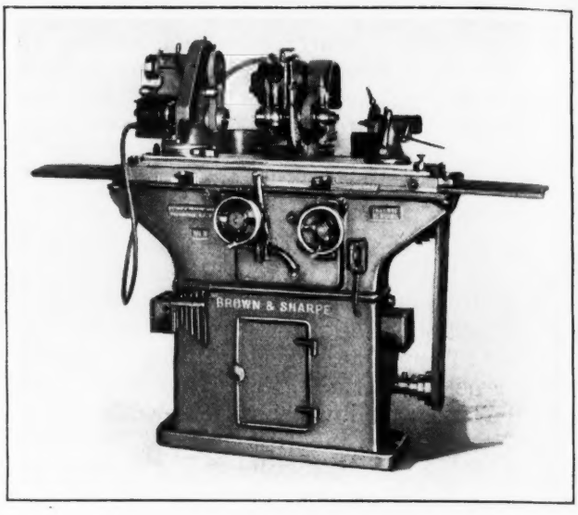


Fig. 1. View of Brown & Sharpe Grinding Machine, Showing Two of the Three Motors

motors are mounted on the headstock, wheel-stand, and at the rear of the machine, respectively.

The wheel-truing attachment, which is shown in Fig. 2, is designed to provide an accurate means of shaping abrasive wheels used on the No. 2 surface grinding machine. It is particularly useful when grinding such work as lamination dies, flat forming tools, and other miscellaneous pieces requiring wheels having radial or angular faces.

The attachment consists of a cast-iron base graduated to 90 degrees each side of zero and carrying a swivel platen. A slide that can be adjusted longitudinally, by means of a handwheel, to sixty-fourths of an inch on each side of a zero graduation, is mounted on this platen. There is an upright integral with the slide, which holds the diamond tool and its setting gage.

By the use of this attachment, outlines having concave or convex radii varying from zero to one inch can be formed, and face angles up to 90 degrees, either side of zero. Numerous combinations of radial and angular shapes can easily be developed. Convex and concave shapes are obtained by setting the slide to the desired radius through the use of the scale and clamping it in position. After the diamond point has been set by means of the gage, the diamond is swiveled through an arc to

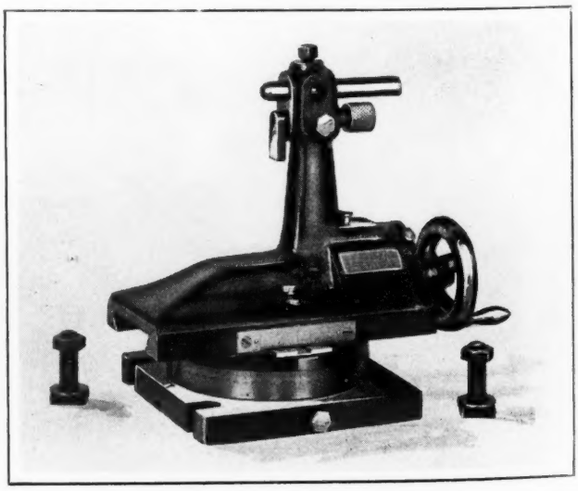


Fig. 2. Radius and Angular Wheel-truing Attachment

develop the required shape on the wheel. Angular faces are formed by clamping the swivel at the proper angle and operating the slide by turning the handwheel.

OLIVER TILTING-ARBOR MOTOR-DRIVEN SAW BENCH

The No. 191 tilting-arbor motor-driven saw bench now being introduced on the market by the Oliver Machinery Co., Grand Rapids, Mich., is designed along the same lines as the larger type of tilting-arbor saw bench described on page 486 of February, 1928, MACHINERY. The table of this machine remains stationary and level at all times, the saw being raised or lowered to change the depth of cut. The saw is tilted for cutting at angles, and the

Oliver Motor-driven Saw Bench with Tilting Arbor

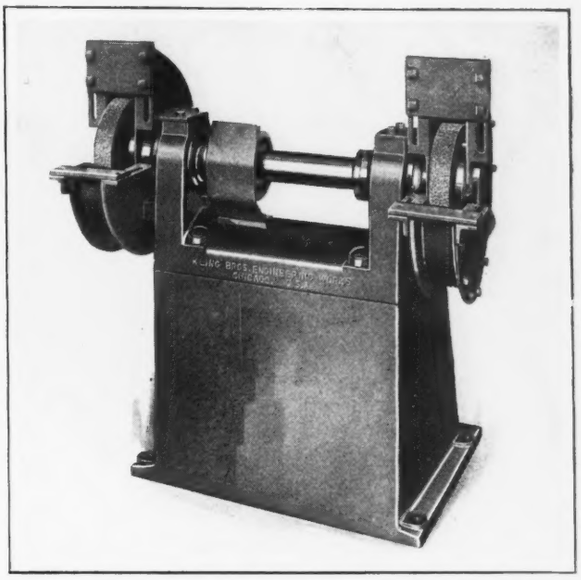
angle of inclination is shown on a graduated scale at the front of the machine. Operation of the saw is controlled by means of a switch conveniently located.

The machine is portable, and is driven by a 1/2-horsepower ball-bearing motor, which may be operated from a light socket. Lumber can be cut to a depth of 2 inches with a standard 7-inch saw, and to 2 1/2 inches with an 8-inch saw. The table measures 25 by 30 inches.

KLING HIGH-SPEED GRINDERS

Peripheral wheel speeds of 9000 surface feet per minute are provided on machines of a new line of small-sized bench- and floor-type grinders being placed on the market by the Kling Bros. Engineering Works, 1300 N. Kostner Ave., Chicago, Ill. A floor-type machine is shown in the illustration.

These type B grinders are made with cast semi-steel frames, and have wheel shafts that are finished all over and fitted with double-row radial ball bearings. The chucks are also steel castings, and are finished and balanced. The wheel guards are fabri-

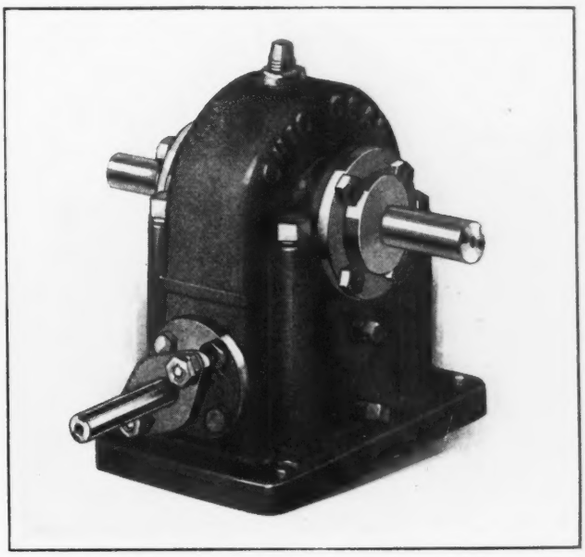


Kling Grinder Designed for Operation at a Wheel Speed of 9000 Feet per Minute

cated of steel to conform with the Safety Code of the American Standards Association. These grinders are made for use with 18- by 2- by 7-inch rubber- or bakelite-bonded grinding wheels in high-speed rough-grinding and snagging.

OHIO SMALL-CAPACITY WORM-GEAR SPEED REDUCERS

A series of small worm-gear speed reducers just developed by the Ohio Gear Co., 1333 E. 179th St., Cleveland, Ohio, includes four sizes, the largest of which is rated at 2 horsepower. These reducers are equipped throughout with Timken tapered roller bearings to insure long service under high speeds and hard usage. Hardened worms with ground threads and phosphor-bronze worm-wheels are provided. Owing to the method of construction, these reducers can be furnished in many ratios, practically any ratio between 6 to 1 and 100 to 1 being obtainable.



Ohio Worm-gear Speed Reducers Made in Ratings up to 2 Horsepower

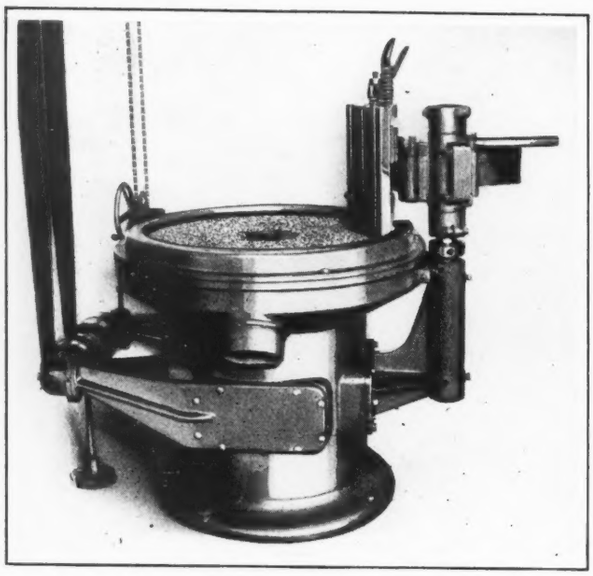


Fig. 1. Gardner Horizontal-disk Grinder with Hand-operated Swinging Work-table

SWINGING WORK-TABLE FOR GARDNER VERTICAL-SPINDLE GRINDER

A hand-operated swinging work-table has recently been developed by the Gardner Machine Co., 414 East Gardner St., Beloit, Wis., for application to the Gardner No. 86 vertical-spindle disk grinder which is equipped with a 30-inch grinding member. With the standard machine of this type, which was described on page 916 of July, 1926, MACHINERY, flat surfaces of many parts can be ground, but without any accurate relation to other surfaces of the parts. However, when the grinder is equipped with the new work-table shown in Fig. 1, one face of the work can be ground freehand until flat, and then by placing the piece on a suitable fixture carried by the work-table, a second face can be ground in accurate relation to the first.

The table pivots on a shaft carried in a bracket fastened to the machine base. From Fig. 2 it will be seen that the guard ring of the machine is cut away to permit swinging the work-table with the work across the grinding wheel. Two conveniently located handles are employed for this purpose. The table is raised from and lowered to the grinding wheel by means of a locking hand-lever. Spring tension furnishes the necessary pressure of the work against the wheel while grinding.

In the normal grinding position, the work-table forms an angle of 90 degrees with the cutting surface of the grinding member. Longitudinal adjustment of the work-table up to 7 inches is available through the horizontal bar slide, while vertical adjustment is obtained by merely raising or lowering the rocker box on the pivot shaft. The work-table may be positioned from 0 to 4 inches above the grinding member. The table top measures 8 by 14 1/2 inches.

The casting shown being ground in Fig. 2 is a crankcase cover for a small gasoline engine. After the bottom surface of this part has been ground freehand until flat, the part is placed in the fixture as shown for grinding a side square with the bottom. Twenty-five pieces are put through the two operations per hour.

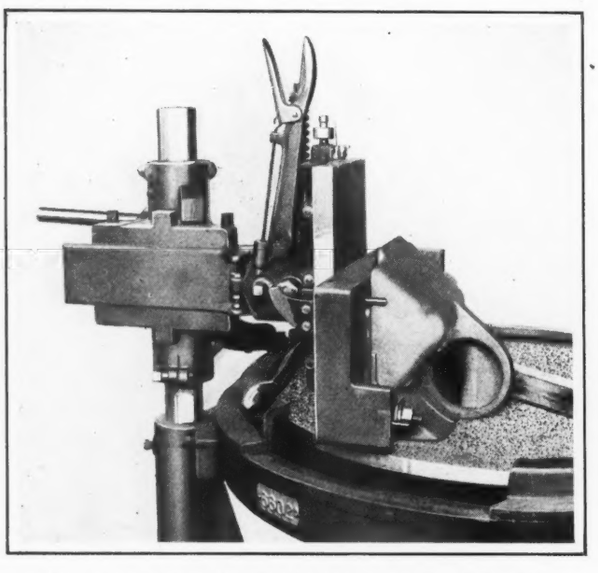
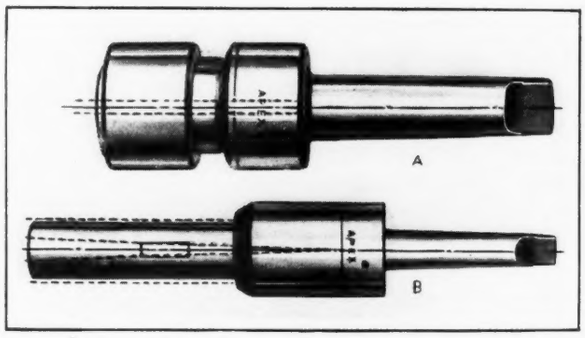


Fig. 2. Swinging Work-table Used for Grinding One Surface of a Casting Square with Another

APEX FLOATING TOOL-HOLDERS

Two tool-holders that have a floating action to permit tools to position themselves relative to the work have been added to the line of quick-change drilling and tapping chucks made by the Apex Machine Co., Dayton, Ohio. The tool-holder shown at *A* allows the tool to enter the work on a straight line in cases where the machine spindle and the work do not line up, but their axes are parallel. This tool-holder has 3/16 inch of float, 3/32 inch on each side of the center.



Apex Tool-holders Designed to Compensate for Misalignment between Machine Spindles and Work

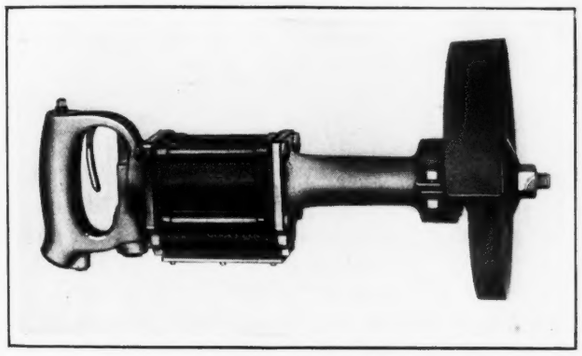
The tool-holder at *B* in the illustration is of a full-floating self-aligning design, and is intended for use in single- or multiple-spindle operations. It will not only allow the tool to float parallel to the axis of the rotating work, but, in addition, will take care of any angular irregularities between the tool and the work. This tool-holder is furnished in several sizes.

Both devices are provided with ball bearings in order to eliminate friction. They are furnished with either straight or Morse taper shanks and with the bottom designed to receive tools having straight or Morse taper shanks, without the necessity of using collets. The bottom may also be equipped with the Apex quick-change drill chuck to enable the using and instant changing of different tools.

ROTOR GRINDER FOR USE WITH HIGH-SPEED WHEELS

A high-production model D-3 grinder, designed for use with 8- by 1-inch high-speed rubber, bakelite, and elastic bonded wheels, is the latest addition to the line of portable pneumatic tools manufactured by the Rotor Air Tool Co., 5905 Carnegie Ave., Cleveland, Ohio. This grinder is particularly suitable for use on steel, electric and oxy-acetylene welds, and malleable iron.

In order to provide the required surface speed of 9000 feet per minute for 8-inch wheels, the new grinder operates under load at 4300 revolutions per minute. A new patented governor controls this speed, regulating the intake air and keeping the machine at a constant speed under load. The grinder also incorporates new rotors which have increased the power substantially. These rotors are accurately balanced, so that the grinder runs without vibration, thus tending to eliminate the wearing of wheels out of round and increasing wheel life. The grinder weighs 16 pounds, with the guard. It is furnished with either a straight or a spade type of handle.



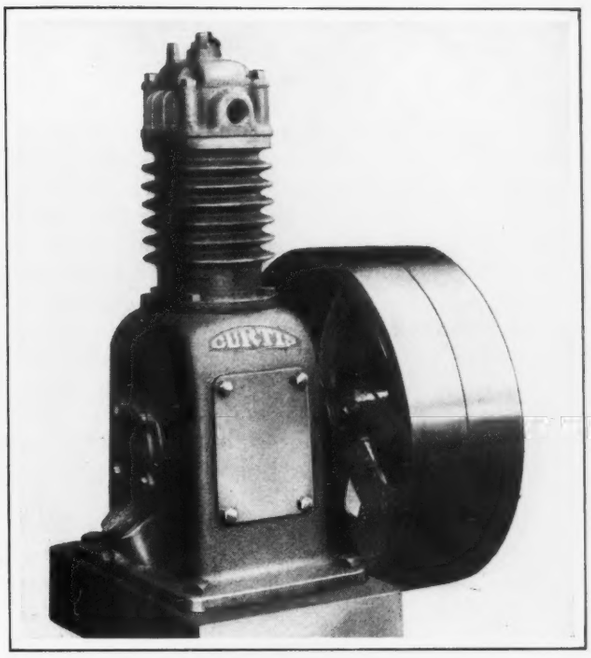
Rotor Air-operated Grinder which Operates Under Load at 4300 Revolutions per Minute

CURTIS TIMKEN-BEARING AIR COMPRESSORS

Water- and air-cooled compressors, equipped with Timken tapered roller bearings and intended primarily for supplying air to such intermittently used pneumatic tools as drills and riveters, and to air hoists, industrial paint-spraying equipment, etc., are being placed on the market by the Curtis Pneumatic Machinery Co., 1905 Kienlen Ave., St. Louis, Mo. The complete line includes eleven models of various types and sizes, ranging from 1/4 to 5 horsepower in capacity and giving pressures of from 150 to 200 pounds per square inch. Water-cooled compressors are made by this company in sizes up to 50 horsepower.

Unit equipments embodying the new small compressors, of both the stationary and portable types, are also built with or without tanks. The compressors alone can be furnished for installation in connection with existing lineshaft, electric motor, or gasoline engine drives.

There are three general classes of compressors in the line—the single-cylinder single-stage; the two-cylinder single-stage, which is known as the duplex; and the two-stage. All types are designed for either automatic or manual starting. The main bearings are Timken tapered roller bearings. These roller bearings are contained in simple housings

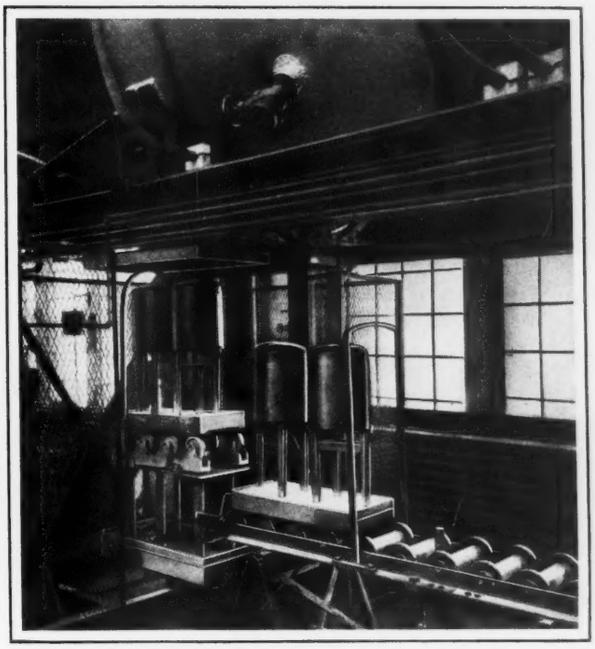


Curtis Air Compressor of the Single-cylinder Single-stage Air-cooled Type

that prevent the escape of lubricant and the entrance of dust or other foreign matter. Automatic lubrication of working parts is insured by the "Centro-ring" oiling system.

GENERAL ELECTRIC CONTINUOUS HYDROGEN BRAZING FURNACE

An automatic brazing furnace employing the hydrogen method has recently been placed on the market by the General Electric Co., Schenectady, N. Y. This furnace is of tunnel-type construction, the furnace proper resting on supports above a roller conveyor, as shown in the illustration. On the conveyor are placed trays on which the work is loaded. The furnace itself has openings at each



Charging Work into General Electric Hydrogen Brazing Furnace

end, in the bottom. Motor-operated elevators located beneath the furnace openings raise the trays of work into the furnace at one end and lower them from the furnace at the opposite end.

A motor-operated ram pushes one tray at a time, from the conveyor onto the intake elevator, both elevators then ascending automatically until the one that is loaded brings its work into the heated end of the furnace and the empty one is in position to receive a tray of brazed work at the discharge end. Another motor-operated ram then pushes the intake tray into the furnace and pushes out a tray of completed work on the elevator at the other end, the furnace being equipped with a conveyor system similar to that below it. Both elevators then again drop to the lower position and the cycle is repeated.

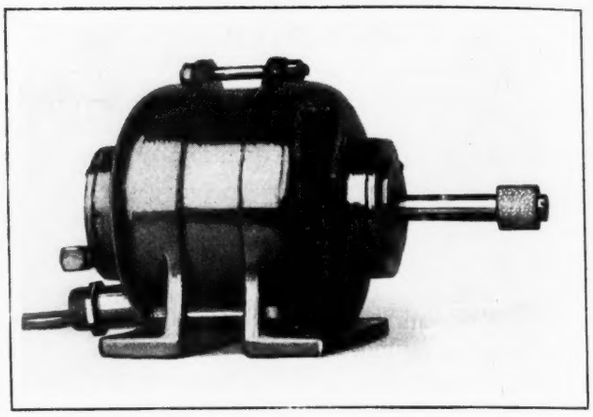
The heating units are arranged in several zones at the entrance end of the furnace, the temperature being automatically controlled. There is a short neck just beyond the heating zone where some cooling takes place, while the remainder of the furnace is water-jacketed for the final cooling. This is so effective that when the work leaves the furnace it has reached a temperature below that at which oxidation will take place.

The work is arranged on vertical supports, when loaded on the trays. In passing through the heated end of the furnace, the trays are carried in a lower chamber, and the vertical supports project up through a slot, thus keeping the work in the heated portion of the furnace while the trays are protected. As a further protection, the trays are covered with heat insulating material.

In preparing the work for brazing, the parts are either wound with copper wire or coated with copper paint. The effect of the gaseous atmosphere (a mixture of hydrogen and nitrogen) is that of a flux, cleaning the work and causing a very smooth flow of the liquid copper over the surfaces to be brazed.

FORBES & MYERS HIGH-SPEED GRINDERS FOR DIEMAKERS

In making dies, small openings in the work often necessitate the use of small grinding wheels, and

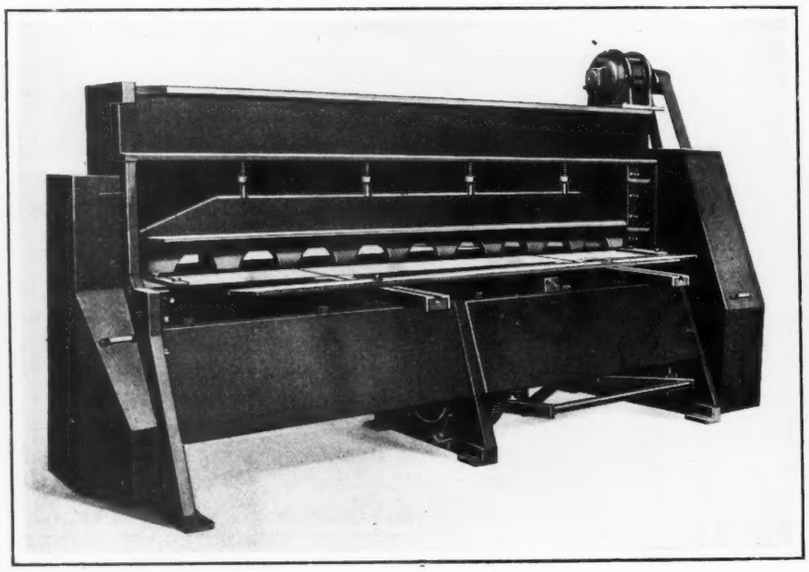


High-speed Grinder which Runs at 25,000 Revolutions per Minute

for efficient grinding, these wheels must be run at very high speeds and maintain their speed under load. For such service, Forbes & Myers, 172 Union St., Worcester, Mass., has brought out a line of grinders, the smallest size of which is shown in the accompanying illustration. It has a rating of 1/4 horsepower, runs at 25,000 revolutions per minute, and is provided with a 3/4- by 3/4-inch wheel. The wheel is held by means of a 1/4-inch screw to the 1/2-inch shaft of the unit. Other sizes up to 1 horsepower are built in the higher speeds, and up to 2 horsepower in slower speeds. They are made for one or two wheels.

The motor and grinding wheels of these grinders are mounted on the same shaft, and the motors have no brushes or commutators. Rotor parts are welded into one solid piece. The ball bearings provided are lubricated through an automatic oil feed.

The high speeds are secured through the high frequency system which requires one more motor than spindles, but the saving in brushes or belts is said to more than make up for the additional motor. Standard power current goes to the first motor, called a frequency changer, which changes the current received into whatever current is desired. If changed to 420-cycle current, the high-speed motors can be operated at 12,500 or 25,000 revolutions per minute. It is possible to get three or four speeds from a single frequency changer, but usually when more than two speeds are desired, an extra frequency changer is preferred for each additional pair of speeds.



Dreis & Krump Shears of All-steel Electric-welded Construction

DREIS & KRUMP ALL-STEEL SQUARING SHEARS

Squaring shears built throughout of steel plates, electrically welded together, have been added to the line of sheet-metal working machinery made by the Dreis & Krump Mfg. Co., 74th St. and Loomis Blvd., Chicago, Ill. Timken tapered roller bearings are provided on the flywheel shaft of these machines to insure ease of operation and saving of power. The hold-down furnished insures a uniform pressure on the metal before the

cutting operation is started, and this pressure is maintained until the completion of the stroke.

Standard equipment of these shears includes a centralized lubrication system operated by means of a hand-plunger; the plunger oils the slides and all bearings, with the exception of the Timken bearings, which require greasing, and the clutch. The latter is equipped with either oil or grease cups. The shears are completely guarded on both ends, at the front and at the rear with heavy steel sheets. These "Chicago" steel power shears are built in lengths of from 3 to 12 feet to cut mild steel from No. 14 gage to 1/2 inch thick.

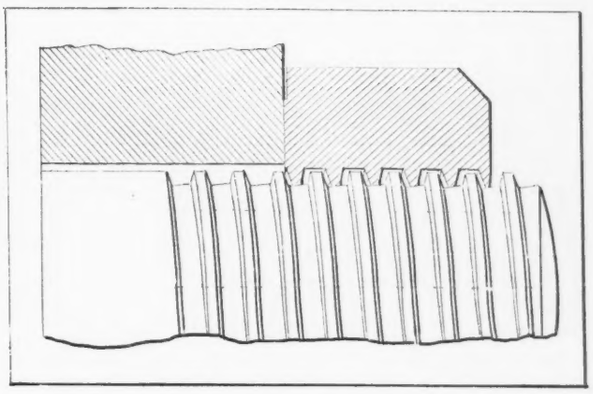
PARKER-KALON "SCREWNAILS"

Combination screws and nails for fastening sheet metal to wood are being placed on the market by the Parker-Kalon Corporation, 200 Varick St., New York City. These "Screwnails" are driven like nails, but the needle-pointed pilot enables them to be driven through much heavier sheet metal than ordinary nails, without bending. A hardened spiral thread on each "Screwnail" forms a thread in the metal burr and wood so as to securely fasten the sheet metal to the wood.

DARDELET "THREADLOCK" BOLTS AND NUTS

Bolts and nuts with a new form of screw thread which automatically locks the nuts and bolts without the use of cotter-pins, lock-washers, etc., are being placed on the market by the Dardelet Threadlock Corporation, 120 Broadway, New York City. As may be seen in the illustration, the Dardelet thread has a slope at the root of the bolt thread which rises toward the point of the bolt, and a corresponding slope on the ridge of the nut thread. The threads are of such cross-sectional contour as to allow axial play between the nut and bolt within fixed limits. While in engagement, the opposed sloping faces are jammed against each other by a crosswise wedging movement.

When a Dardelet nut is screwed on a bolt, the nut first advances along the bolt with the conical surfaces lightly in contact. Then, as the nut seats on the work, the conical surfaces are forced into closer contact and the material of the nut is stretched within its elastic limit until the approximately square abutment faces of the threads are in contact. The nut is then under stress and is locked to the bolt by friction with a force sufficient to prevent it from being loosened by vibration or jarring. The lock thus produced is effective at any point along the threaded length of the bolt. The effort required to place a given pressure on the work is said to be less than that required in the case of a standard V-thread.



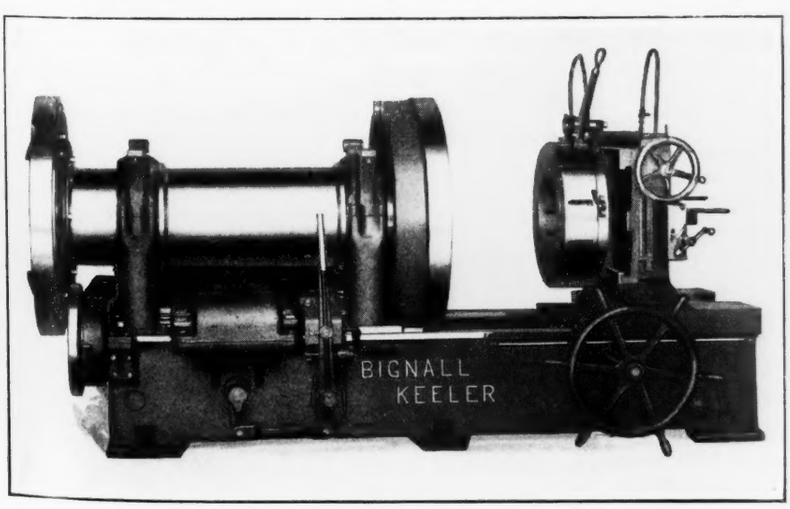
Dardelet "Threadlock" Form of Thread which makes Bolts and Nuts Self-locking

BIGNALL & KEELER DUPLEX PIPE MACHINE

All sizes of pipe, casing, and tubing, from 4-inch pipe to 13 3/8-inch A.P.I. casing, can be handled in a No. 12 duplex pipe threading and cutting-off machine recently brought out by the Bignall & Keeler Machine Works, Edwardsville, Ill. This machine has been designed especially for oil-field service.

Eight speed changes are provided through broad-face, steel cut gears running in oil in a compact gear-box, the lower half of which is part of the bed casting. One set of gears is located outside the gear-box. A two-way positive clutch provides for stopping and starting the machine quickly, and also enables the operator to shift rapidly to a high speed for cutting off operations on large sizes of pipe.

A three-jaw independent chuck is mounted on each end of the arbor. Either or both of these chucks may be used during the threading and cutting operations. The rear chuck is equipped with flanged grippers for use in making and breaking up flanged fittings. The "Peerless" sliding die-head provided can be arranged for dies of any width. Dies 2 11/16 inches wide are recommended by the builder for standard pipe threading, 3 7/16 inches wide for D.B.X. casing, and 4 7/16 inches wide for A.P.I. drill pipe and casing work. Full-length threads are cut with one pass of the die-head. The dies may be changed quickly from one size, taper, or thread to another.

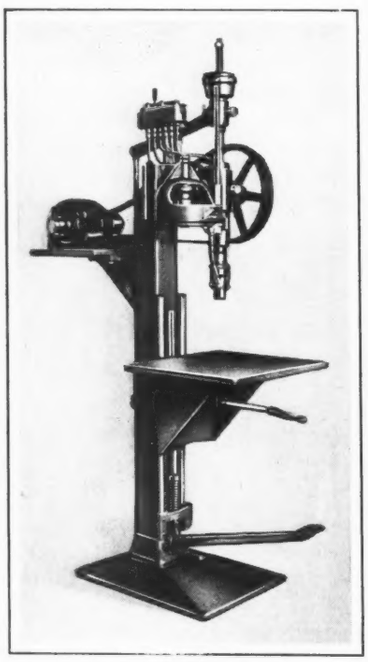


Bignall & Keeler Pipe Threading and Cutting-off Machine

Cutting-off, beveling, and reaming tools are furnished as regular equipment. The carriage has 33 inches of travel. Reversing for left-hand threading and for pulling collars is accomplished through the countershaft or motor, depending upon the type of drive employed. Equipped with a belt drive, the machine weighs approximately 12,000 pounds, and with a motor drive, 13,000 pounds.

REYNOLDS AUTOMATIC MAGAZINE-FEED SCREWDRIVING MACHINE

A No. 2 medium-size heavy-duty magazine-feed screwdriving machine recently developed by the Reynolds Machine Co., Massillon, Ohio, will drive any three consecutive sizes of wood or machine screws from Nos. 6 to 14, inclusive, without any changes or adjustments. Screws smaller than the No. 10 size, up to 1 1/2 inches long, can be handled and from Nos. 10 to 14, inclusive, up to 1 3/4 inches long. Sets of parts that are quickly interchangeable can be furnished to increase the range of screws driven. No changes are necessary for screws of different lengths.



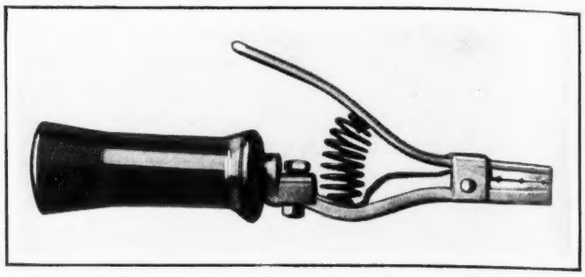
Reynolds Automatic Screwdriving Machine

Screws can be driven at the center of an 18-inch circle in work not over 18 inches high. When the work requires a greater depth of throat, a gap column may be substituted which allows screws to be driven in the center of a 48-inch circle on work not over 6 inches high. A boring attachment can be furnished when it is necessary to bore holes before driving the screws. A single-spindle or a cluster head can be provided.

The machine may be equipped with a motor plate and bracket for an individual motor drive. Spindle speeds of from 700 to 850 revolutions per minute and upward, depending upon the character of the work, are recommended. From one to two horsepower is required for operating the machine. The main bearings are lubricated by means of a gravity oiling system.

LINCOLN ELECTRODE HOLDER FOR METALLIC ARC WELDING

An improved type T electrode holder for metallic arc welding, which has been designed for greater operator convenience, is being announced to the trade by the Lincoln Electric Co., P. O. Box 683, Cleveland, Ohio. This holder consists essentially of a strong clamp for holding the electrode firmly while welding. An easy release feature permits of quickly changing electrodes.



Lincoln Improved Electrode Holder for Metallic Arc Welding

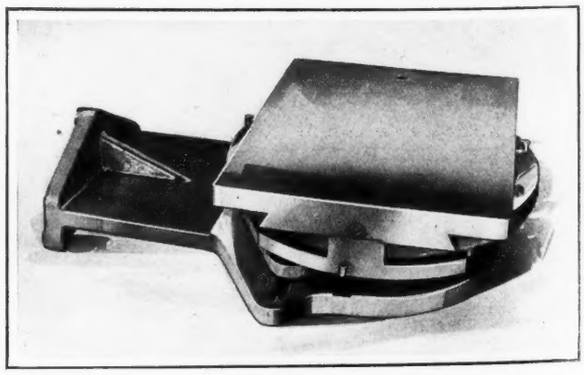
The handle grip is designed for easy holding and it is claimed that the holder remains exceptionally cool because of the welding current being carried from the point of cable entry to the copper jaws by copper strips of low resistance. The copper tips on the jaws reduce sticking of the electrode to the jaws, resulting in faster and easier changing of electrodes and longer life of the holder.

The shape of the holding clamps has been altered to give greater compactness to permit working in close corners. All metallic parts of the holder are coated with non-tarnishing cadmium-plating.

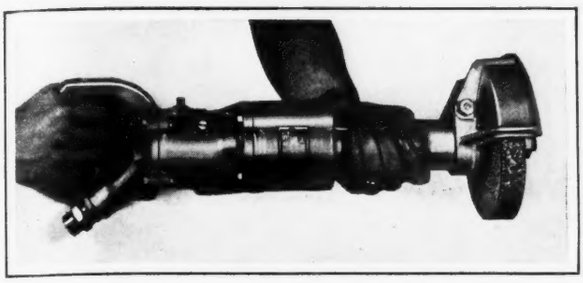
FREW ELLIPTIC CHUCK FOR VERTICAL TURRET LATHE

The elliptic chuck built by the Frew Machine Co., 132 W. Venango St., Philadelphia, Pa., is normally furnished for attachment to the spindle of ordinary lathes, but recently a special adaptation of the chuck was furnished for use on a Bullard vertical turret lathe. The purchaser of this chuck had to turn a large ellipse on castings which, with the fixture, weighed approximately 800 pounds. This made the load too heavy to be suspended on a lathe spindle, and hence the chuck illustrated was designed to permit the operation to be performed on the vertical turret lathe.

The feet of the chuck are clamped against the column of the vertical turret lathe, and the revolving chuck member is fastened to the table of the machine. The faceplate of this chuck measures 16 1/2 by 21 inches, and is used to turn ellipses measuring 18 by 16 inches. Incorporated in the attachment is a means for varying the relation between the two axes of the ellipse.



Frew Elliptic Chuck Designed Primarily for Use on a Vertical Turret Lathe



Hercules Portable Pneumatic Grinder

HERCULES PORTABLE PNEUMATIC GRINDER

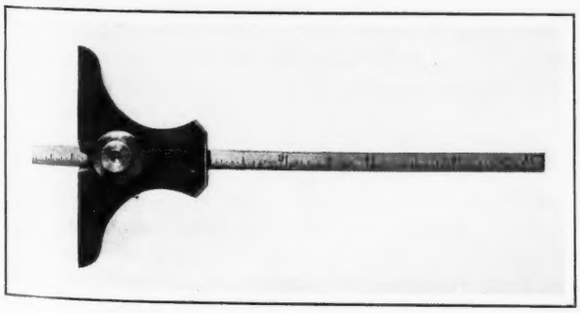
The portable air grinder now being introduced to the trade by the Buckeye Portable Tool Co., Dayton, Ohio, is lighter in weight than the previous model and is smaller in diameter, so that it is better adapted for working in narrow places. It is equipped with a new type of governor which regulates the flow of air into the rotor in such a way that, while running free, the air consumption is unusually low. As the grinding pressure is applied, the governor allows more air to pass into the rotor.

It is claimed that the grinding speed is maintained close to the standard free speed. It is also stated that there need be no fear of using the grinder because of danger of wheel racing should the governor break, as, in such an event, the governor would stop the tool instead of increasing the speed. This No. 300 series grinder can be furnished with speeds regulated for either vitrified or high-speed emery wheels and for both 6- and 8-inch wheels.

BROWN & SHARPE COMBINATION DEPTH GAGE AND PROTRACTOR

A No. 616 rule depth gage recently introduced to the trade by the Brown & Sharpe Mfg. Co., Providence, R. I., has the additional feature of serving as an easily adjusted protractor. When the device is to be used as a protractor, the blade is easily locked at any angle in relation to the head. This is accomplished by means of the larger of the two clamp nuts on the front side of the head. To facilitate settings, the turret is graduated every 10 degrees from 0 to 90 degrees.

The smaller clamp nut on the front side of the head is employed to lock the blade to the head in various positions for use as a depth gage. The blade is 6 inches long, and is graduated in thirty-seconds and sixty-fourths of an inch, or in millimeters and half-millimeters.

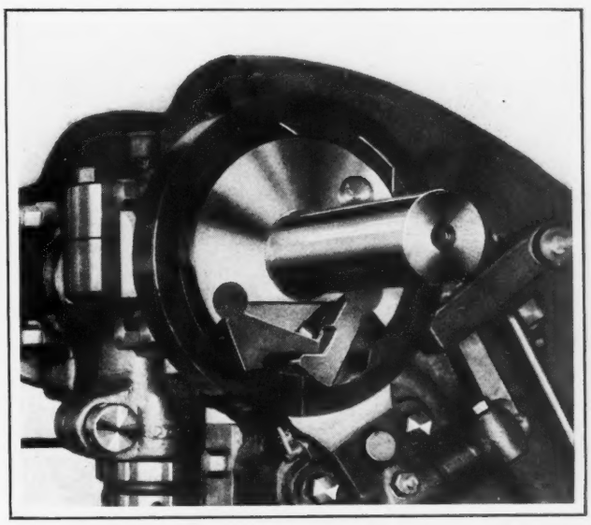


Brown & Sharpe Rule Depth Gage and Protractor

DOUBLE-PAWL CLUTCH FOR "CANCO" PRESSES

Power presses made by the Equipment Division of the American Can Co., 120 Boadway, New York City, may now be furnished with the double-pawl clutch here illustrated in place of the single-pawl clutch with which the machines have hitherto been provided. This line of presses was described on page 872 of MACHINERY for July, 1928. In the new clutch there is a locking pawl in addition to the striking pawl, which works in the opposite direction to the striking pawl and eliminates rebounding of the press slide at the bottom of the stroke, since it prevents the crankshaft from overtaking the flywheel.

In developing the new clutch, the strength of the original design has not been impaired nor has the speed of press operations been reduced. The double-pawl type of clutch is particularly recommended for deep drawing work, as in its operation the flywheel is securely locked to the clutch collar until the stroke is completed. The "Canco" cam-operated brake is also designed to prevent rebound and backlash.



"Canco" Power Press Equipped with Double-pawl Clutch

Disengagement of the locking pawl is positive and the pawl is returned to its free position by the clutch pawl itself when the latter is disengaged from the driving position by the same type of trip as is used with the single-pawl clutch. A locking arrangement is provided on this trip so that the treadle cannot engage the latch when a workman is setting dies or working under the punch.

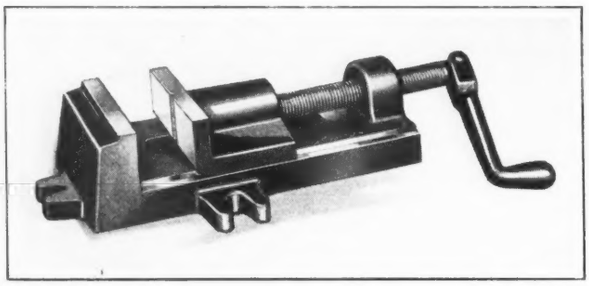
The locking pawl, like other members of the clutch, is made of tool steel and is hardened and ground. There are only two moving parts in the clutch and no springs are employed. While the crankshaft has been modified to suit the new clutch, the crankshaft diameter has not been changed. This part is made of chrome-nickel steel, heat-treated and ground, as before. The brake is so designed that the crankshaft always stops in a position where both pawls will drop into the locking position by gravity.

This double-pawl clutch has been adopted as standard equipment on all "Canco" OBI presses

and can be used on horn presses, although the nature of the work performed by machines of the latter type does not usually require the double-pawl clutch.

"AMMCO" DRILLING MACHINE VISE

A drilling machine vise having jaws 3 1/2 inches wide by 1 1/2 inches deep, which open 4 1/2 inches,



"Ammco" Vise for Use on Drilling Machines

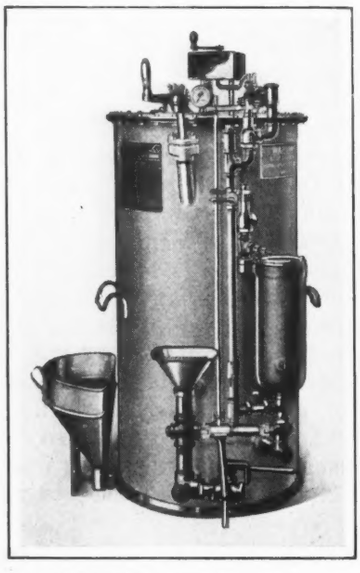
is being introduced to the trade by the Automotive Maintenance Machinery Co., 816 W. Washington Blvd., Chicago, Ill. This "Ammco" vise is intended for use in garages, service stations, or machine shops. It provides a quick and easy means of setting up all kinds of drilling jobs.

The jaws are machined, a V-shaped slot in the movable jaw affording positive clamping of work held vertically. The swivel handle facilitates the use of the vise in cramped positions. This handle can be swung back out of the way when necessary.

"PREST-O-WELD" MEDIUM-PRESSURE ACETYLENE GENERATOR

The acetylene generator here illustrated is intended for use with either medium- or low-pressure welding and cutting blow-pipes. This "Prest-O-Weld" type MP-101 generator has been developed by the Oxweld Acetylene Co., 30 E. 42nd St., New York City. It can be easily transported from place to place on a truck or wagon.

Heavy gage material has been used in the construction of the generator, and wherever strength is required of the fittings, steel castings are employed. The generator shell and fittings are joined by bronze welding. All parts are either galvanized or sherardized, according to the conditions to which they are to be subjected. The carbide valve is rotated by means of a spring clock motor which is governed by an "Oxweld" diaphragm-type motor feed control. This valve is self-cleaning.



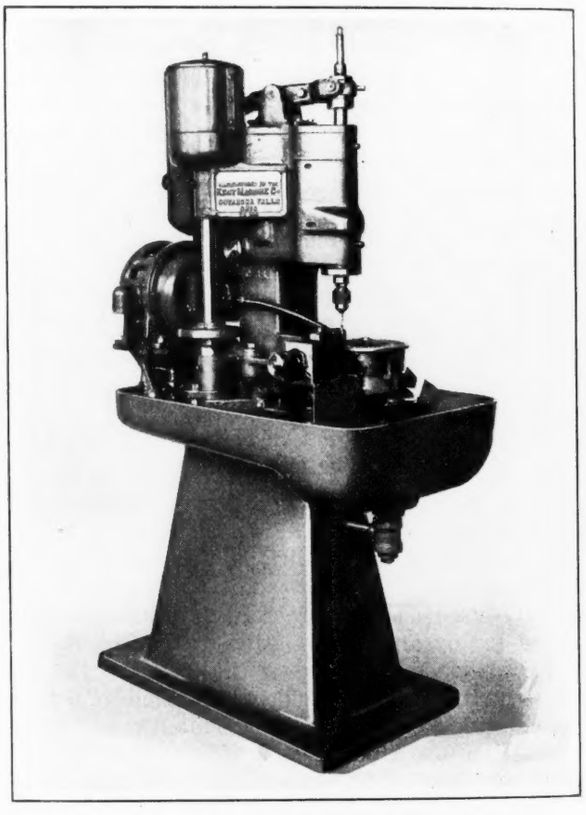
"Prest-O-Weld" Acetylene Generator

The rated capacity of the generator is 60 cubic feet per hour. Its over-all dimensions are 60 by 34 inches. The weight, when empty, is 305 pounds, and with a full charge of carbide and water, 623 pounds.

KENT DIAL-FEED DRILLING MACHINE

Rapid drilling, burring, or countersinking of parts that can be fed by a dial plate and clamped during the machining can be performed on a machine recently developed by the Kent Machine Co., 268 N. Water St., Cuyahoga Falls, Ohio. Aside from placing the parts on the dial plate, the machine is continuous and entirely automatic in action. It has been designed with a view to reducing the "air cutting" or idle time to the minimum.

The method of feeding depends to a large extent upon the shape of the piece. When the end of the



Kent Dial-feed Machine for Rapid Drilling, Burring, or Countersinking

head on cap-screws or similar parts is being drilled, the dial carries the work to a position under the spindle, where it is centralized by a pair of jaws which grip the body of the part. One of these jaws is fixed, but can be adjusted to suit various sizes of work, while the other jaw is movable and actuated by a cam.

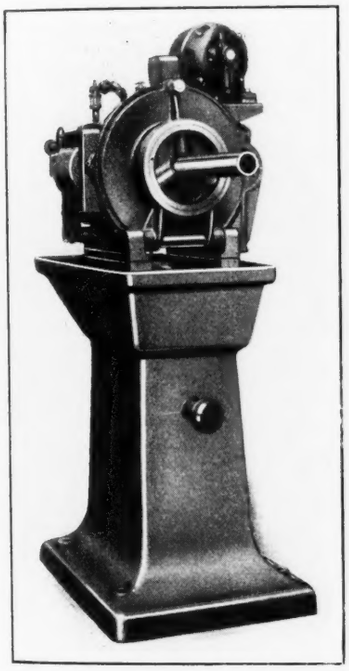
For drilling at right angles to the center line of a cylindrical piece, the dial plate can be provided with radial slots and the jaws made to clamp the ends of the part before the drilling takes place. Thus it will be seen that the dial feed and clamping mechanism can be arranged to accommodate a variety of work of different designs. A bracket holds a guide bushing directly above the work. After

the parts have been drilled, the dial plate carries them around to a discharge chute.

To make the machine still more individual in its application, and to take advantage of all speeds and feeds for various designs of parts, the speed of the camshaft that controls the timing operations can be so regulated that full capacity of the drill and machine may be obtained. The machine has a capacity for driving drills up to 3/8 inch in steel to a depth of 3/4 inch. It can be furnished with a belt or constant-speed motor drive, and it may be mounted on a pedestal as shown or arranged for bench use. The weight of the floor-type machine is 1350 pounds.

OSTER REVOLVING-HEAD BLADE-TYPE CUTTING-OFF MACHINE

The revolving-head blade-type cutting-off machine here illustrated has recently been placed on the market by the Oster Mfg. Co., Cleveland, Ohio. This equipment has a capacity for from 3/8- to 2-inch solid stock and 1/4- to 1 1/2-inch pipe or tubing. The machine is driven by a universal motor, operating on 110-volt single-phase alternating current of any cycle from 25 to 60, or 110-volt direct current.



Oster Revolving-head Cutting-off Machine

The main reason for using this type of motor is that its speed is governed by the load put on the machine, and therefore the spindle speed throughout the entire operation increases inversely with the diameter of the stock being cut. Also, the functioning of the machine during the return of the blades for the next cut is at the highest speed of which the machine is capable. The motor is provided with a start and stop trigger switch into which a circuit breaker is built to protect the motor from overload.

The drive from the motor is through a silent chain to a jack-shaft mounted in Timken tapered roller bearings. This jack-shaft carries the speed clutches and drives the spindle, which is also mounted in Timken bearings at both the front and rear. The cutter-head is provided with two cut-off slides mounted opposite each other in adjustable gibs in the head and protected from undue wear by felt wipers. These slides are operated radially by a scroll cam which is mounted on the head and driven through the medium of the jack-shaft. The speed of the slides in and out is controlled by a differential action of the scroll relative to the cutter-head.

Two cutting tools, one ground to a U.S.S. thread form and the other flat, are mounted in the slides. The form tool is set one-half vee in advance of the flat tool, thus splitting the cut into three chips and insuring long life of the blade. The tools are so mounted in the slides as to give proper rake. Hence, only end grinding of the parting tools is necessary. Setting of the blades relative to the center of the bore is accomplished by the use of a simple gage.

The machine is equipped with a universal lever-operated scroll chuck, which has two sets of three serrated jaws each. Except on tubing, one operator can handle two or more machines, depending on the diameter of the stock being cut off.

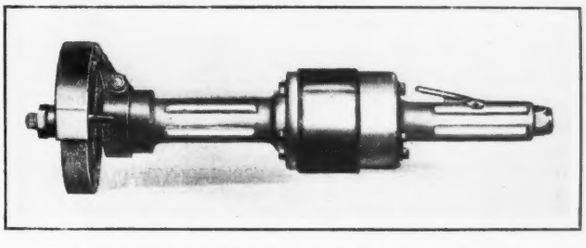
INGERSOLL-RAND MULTI-VANE GRINDERS

Portable pneumatic grinders having multi-vane rotors that are said to combine the lugging power of a piston machine with the smoothness of a turbine are a recent development of the Ingersoll-Rand Co., 11 Broadway, New York City. Unusually light weight for their capacities is another advantage claimed for these devices. Governors permit any desired speed up to 6300 revolutions per minute to be obtained, thus enabling grinding wheels of different diameters to be driven at the most desirable cutting speeds. Standard machines are set to run at 4200 revolutions per minute, which is considered the best speed for 6-inch vitrified wheels and 8-inch elastic bonded wheels. The governors also prevent the grinders from operating at dangerous speeds.

The rotor of every grinder has four power vanes, is made of steel, hardened and ground, and has a full-floating fit on the arbor. This fit permits the rotor to align itself between two plates, so that no pressure comes at the ends. The four vanes balance the turning effort on the rotor. There is an exhaust deflector, which also serves as a muffler. The wheel end bearing consists of two radial thrust ball bearings, which are placed to take the thrust from either direction.

In the handle of the tool there is a chamber from which oil is automatically fed into the live air going into the machine. This keeps all wearing parts running in an oil film.

These multi-vane grinders can be used for a wide variety of grinding, buffing, polishing, or cleaning, and when fitted with wire brushes, they are also efficient removers of scale, rust, paint, etc., from steel surfaces. Two types of handles can be furnished, a squeeze-type straight handle or an inside-trigger grip handle.



Ingersoll-Rand Multi-vane Pneumatic Grinder

PERSONALS

ARTHUR E. KALLINICH, formerly New England representative of Veeder-Root, Inc., Hartford, Conn., has been promoted to the position of field sales manager.

K. L. HERRMANN has been made manager of the Bantam Ball Bearing Co., Bantam, Conn., succeeding W. S. ROGERS, whose retirement was announced in March MACHINERY.

CLIFFORD W. STUART, assistant to the manager of the publicity department of the General Electric Co., Schenectady, N. Y., has been appointed assistant manager of the department.

FREDERICK S. BLACKALL, JR. was elected vice-president and general manager of the Taft-Peirce Mfg. Co., Woonsocket, R. I., at a recent meeting of the stockholders and board of directors. Mr. Blackall is the son of the late Frederick S. Blackall, who for many years was vice-president and general manager of the company. Upon his death in October, 1928, his son succeeded him as general manager of the company.

LAMAR S. PEREGOY, vice-president and secretary of the Sivyer Steel Casting Co., Milwaukee, Wis., was made general manager of the company at a recent meeting of the board

F. S. Blackall, Jr.,
General Manager,
Taft-Peirce Mfg. Co.

Lamar S. Peregoy,
General Manager,
Sivyer Steel Casting Co.

of directors. Mr. Peregoy has been connected with the company since its inception. He is also vice-president of the Interstate Drop Forge Co. and a director of the Federal Malleable Co., both Milwaukee concerns affiliated with the Sivyer Steel Casting Co.

CAPTAIN M. F. BEHAR has been appointed advertising manager of the Quigley Furnace Specialties Co., Inc., 26 Cortlandt St., New York City. Mr. Behar has been advertising manager of the C. J. Tagliabue Mfg. Co. since 1924.

CHARLES E. DIEBOLD, formerly tool and machine supervisor in the shock absorber division of the National Acme Co., Cleveland, Ohio, has been appointed a sales engineer for the company, specializing on Acme and Gridley automatics.

K. G. BAKER has been added to the Cincinnati sales force of the Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo. Mr. Baker was previously connected with the Century Electric Co. and the Fulton Iron Works, both of St. Louis.

MARTIN A. FLADOES, sales manager of the Sivyer Steel Casting Co., Milwaukee, Wis., was made a director of the company at a recent meeting of the board. Mr. Fladoes has been connected with the company in the sales engineering department for about eight years.

W. R. HEROD, formerly of the construction engineering department of the General Electric Co., Schenectady, N. Y., has been appointed assistant to Clark H. Minor, president of the International General Electric Co. Mr. Herod's headquarters will be in New York City.

GEORGE A. WHALON, who has been for several years a manufacturers' agent for machine tools, small tools, and other machine shop equipment in Japan, has returned to the United States to become a machinery salesman for the National Acme Co., Cleveland, Ohio, in the Detroit territory.

W. J. MILLER, formerly president of the Northwestern Steel & Iron Co., Minneapolis, Minn., has recently been appointed vice-president of Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill., in direct charge of the manufacturing and sales of the new Road Machinery Division.

FRED D. BAKER, formerly with the Strong, Carlisle & Hammond Co., Cleveland, Ohio, has become associated with Charles H. Besly & Co., 118 N. Clinton St., Chicago, Ill., as sales engineer, and will have charge of the sale of Besly grinders and Titan abrasive disks in the Cleveland, Erie, and Buffalo districts.

STUART NARAMORE, who for the last six years has been sales manager of Andrew C. Campbell, Inc., Bridgeport, Conn., manufacturer of nibbling machines, will be connected with the Triplex Machine Tool Co., effective April 1, as Connecticut representative for the distribution of that company's line of machine tools.

H. H. WOOD, formerly chief engineer of the Laclede Steel Co., St. Louis, Mo., has joined the Industrial Department of the Timken Roller Bearing Co., Canton, Ohio. Mr. Wood will specialize in the application of Timken bearings to steel mill equipment of various sorts. For the present his headquarters will be in Canton.

HARRY DOBSON, formerly superintendent of the London, Ontario, and Montreal branch of the Ford Motor Co. of Canada, and later with the White Motor Co. and the Chrysler Corporation, has joined the staff of the Arthur Jackson Machine Tool Co., 9 Front St., East, Toronto 2, Canada. Mr. Dobson will manage the new branch this company is about to open in Windsor, Ont.

GEORGE C. MCKAY has been appointed Ohio branch manager for the Roller Bearing Company of America, Trenton, N. J. Mr. McKay has had a wide experience in the application of anti-friction bearings, having been associated with the S K F Ball Bearing Co. and the New Departure Ball Bearing Co. for over ten years. He will make his headquarters at 420 Sloan Bldg., Cleveland, Ohio.

J. E. MULLEN has resigned as head of the sales department of the Nuttall Works of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., to become associated with the National Foundry Co., Erie, Pa. E. E. Boone will fill the position of gearing apparatus sales manager made vacant by Mr. Mullen's resignation. Mr. Boone will be located at the R. D. Nuttall Works of the company in Pittsburgh.

J. S. SPROTT has been appointed general manager of sales of the Berger Mfg. Co., Canton, Ohio, manufacturer of metal furniture, metal ceilings, and other metal-building products, corrugated metal culverts, and a large number of special fabricated metal products made chiefly from sheet steel. During the last eight years he has been vice-president in charge of sales of the General Fireproofing Co., Youngstown, Ohio.

R. A. SHILBAUER, for several years assistant advertising manager of the Chain Belt Co., Milwaukee, Wis., has been appointed advertising manager, succeeding A. R. ABELT, who will devote his entire time to his duties as sales manager of the chain and transmission division of the company. Mr. Shilbauer joined the Chain Belt Co. as a rate setter in 1920, and in 1925 was transferred to the advertising department.

B. W. DIMEND, who has been in charge of the machine tool department of the Smith Booth Usher Co., Los Angeles, Cal. for several years, has resigned his position, and is leaving for Honolulu for a short vacation. Mr. Dimend was connected for a number of years with the Federal Machinery Sales Co. of Chicago, and later represented the Lees-Bradner Co. in the New York territory for a short time. He does not contemplate making any connection until his return to California.

ADDISON MCGARRETT, formerly with the Niles Tool Works Co. of Hamilton, Ohio, is now manager of the new agency sales department of the Pratt & Whitney Co., Hartford, Conn. Mr. McGarrett was connected with the Niles Tool Works Co. for more than twenty-five years, fifteen of which he spent in traveling through New England, New York, and Ohio. For five years he was manager of the Rochester branch office. ROBERT P. BRINKMAN, who assisted Mr. McGarrett at Hamilton, is with him at Hartford.

LUDWELL H. GILMER, founder and chairman of the Board of the L. H. Gilmer Co., Cottman & Keystone Sts., Tacony, Philadelphia, Pa., has severed his connection with that company, except as a director, to head a new corporation for the manufacture of endless belts. The new company will be known as THE GILMER CORPORATION. It will have headquarters in Detroit, with factory at Auburn, Ind., where it is planned to start production on April 15. Attention will be centered in the beginning on automobile fan belts and other molded rubber products.

P. S. JONES has been made manager of the New York district office of Cutler-Hammer, Inc., 1203 St. Paul Ave., Milwaukee, Wis., manufacturer of electric motor control and allied apparatus. Mr. Jones was formerly manager of the Pittsburgh office. He succeeds C. W. YERGER, who has become connected with the Hanson-Van Winkle-Munning Co., Matawan, N. J. T. S. TOWLE, formerly a sales engineer at the Pittsburgh office, will take Mr. Jones' place as manager at Pittsburgh. G. E. HUNT, who has been connected with the Philadelphia office of the company for the last ten years, has been placed in charge of distributors' sales.

HAROLD KAY has been appointed sales manager of the Haynes Corporation, First National Bank Building, Chicago, Ill., industrial engineers. Mr. Kay will have charge of the St. Louis territory. He was formerly connected with the Sherman Corporation, and prior to that was sales manager of the business management department of the La Salle Extension University. He also served as general manager and president of Harold Kay & Co., of Los Angeles and San Francisco, and vice-president of the Russian American Corporation of New York City. For several years he was special trainer for sales forces in a number of large concerns throughout the country.

James S. Watson, Newly Elected Vice-president, Link-Belt Co.

JAMES S. WATSON has been elected vice-president of the Link-Belt Co., 300 W. Pershing Road, Chicago, Ill. Mr. Watson will make his headquarters at the Dodge Works of the company in Indianapolis, Ind. He has been connected with the Link-Belt Co. for thirty-years, and since 1903 has served as head of the drive chain division. For the last nine years he has been located at the company's Dodge Works at Indianapolis, of which he is general manager.

H. HOBART PORTER has been elected chairman of the Engineering Foundation, joint research instrumentality of the founder engineering societies, to succeed L. B. STILLWELL, who has served since 1925. Mr. Porter has long been active in business, engineering, and science, as well as in the educational and civic life of New York. He is a member of the Division of Engineering and of the executive committee of the National Research Council, and is also a member of the American Society of Mechanical Engineers, the American Society of Civil Engineers, and the American Institute of Mining and Metallurgical Engineers. He became a member of the Engineering Foundation Board in May, 1918, serving until February, 1924, and was re-elected in 1927. He is a trustee of Columbia University, from which he was graduated in 1886 with the degree of M. E. Mr. Porter was born in New York City in 1865, and was engaged in mining engineering in Mexico and Arizona until 1894, when he became a member of the engineering firm of Sanderson & Porter, New York, with which he has since been identified. Other officers re-elected by the Foundation are George A. Orrok and Arthur D. Little, vice-chairmen; and Alfred D. Flynn, director.

HERBERT L. CUMMINGS, for fourteen years connected with the machinery sales department at the Windsor, Vt., plant of the National Acme Co., has been appointed New England representative for the concern. Mr. Cummings will make his headquarters at the New York office, 117 Liberty St.

CHARLES H. KERR has been appointed vice-president and general manager of the Brown Instrument Co., Philadelphia, Pa. GEORGE W. KELLER has been appointed vice-president and general sales manager.

* * *

According to a summary of the Census of Manufactures for 1927, published by the Department of Commerce, Washington, D. C., the total value of the products of the machine shop industries (including industrial machinery and all classes of transportation equipment, and covering both shops building new equipment and those doing repair work) was over $11,300,000,000 in that year. Industrial machinery showed an increase of more than $300,000,000 over 1925.

MACHINE TOOL FIRMS CONSOLIDATE

The consolidation of the New Britain Machine Co., New Britain, Conn., and the Gridley Machine Co., Hartford, Conn., has been announced. The new combination will be known as the New Britain-Gridley Machine Co. and will take over the entire business of the Gridley Machine Co. and the machine tool business of the New Britain Machine Co. The latter company will continue to operate as a manufacturer of screw machine parts, pressed-metal products, shop furniture, socket wrench sets, mortiser machines, and supplies.

The officers of the consolidated concern are: President, Herbert H. Pease, formerly president of the New Britain Machine Co.; vice-presidents, George D. Gridley, formerly president of the Gridley Machine Co.; Ralph S. Howe, formerly assistant treasurer of the New Britain Machine Co.; Donald H. Montgomery, formerly secretary and treasurer of the Gridley Machine Co.; Edward L. Steinle, formerly machinery sales manager of the New Britain Machine Co.; Earl H. Wheeler, formerly vice-president of the Gridley Machine Co.; secretary, Robert S. Brown, formerly secretary of the New Britain Machine Co.; and treasurer, Ralph S. Howe.

George D. Gridley, Vice-president, New Britain-Gridley Machine Co.

Mr. Pease will continue as the active head of the new concern. Mr. Brown has been responsible for the design of the entire line of automatic screw and chucking machines built by the New Britain Machine Co. in the past. Mr. Gridley's experience in the machine tool field covers a period of over thirty years; for the last two years he has been the active head of the Gridley Machine Co., during which time he has developed and built single- and multiple - spindle automatic chucking machines in which are incorporated many new features differing greatly from those of other machines on the market. Mr. Gridley will devote himself entirely to the designing and building of new machines for the consolidated company. Mr. Steinle will remain sales manager. The new company will continue to build and market the machines previously built and sold by the two consolidated companies.

* * *

TRADE NOTES

S-P MFG. CO. has removed its factory to 7209 Platt Ave., Cleveland, Ohio, and will devote its entire attention to the manufacture of air-operated chucking equipment.

WISCONSIN ELECTRIC CO., Racine, Wis., announces that the name of the firm has been changed to the DUMORE CO., INC. The officers, personnel, and policies of the company will remain unchanged.

ERIE CITY IRON WORKS, Erie, Pa., has appointed the Schley-Nash Co., Columbia Bank Building, Fourth Ave. and Wood St., Pittsburgh, Pa., sales representative for the company in the Pittsburgh district.

GEARS AND FORGINGS, INC., 3122 Woodhill Road, Cleveland, Ohio, has established a Milwaukee office at 419 Commerce Bldg. Rober K. Plummer will be district sales representative, in charge of the office.

SKINNER CHUCK CO., New Britain, Conn., has appointed Thomas H. Winston, 14 Guaranty Industrial Bldg., 2401 Chestnut St., Philadelphia, Pa., representative of the company in the Philadelphia territory.

NATIONAL ACME CO., Cleveland, Ohio, announces the removal of its Detroit office and stockroom to a ground floor section in the new building at 2826 E. Grand Blvd. A. O. Bredemere is manager of the Detroit office.

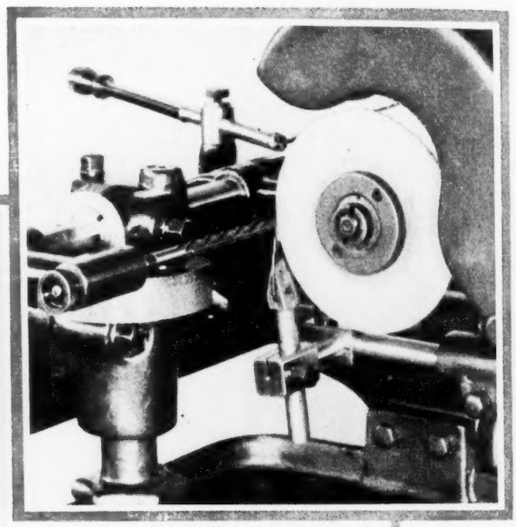
NATIONAL BRONZE & ALUMINUM FOUNDRY CO., Cleveland, Ohio, has just broken ground for a large addition to its plant which will increase the present capacity by 50 per cent. A good deal of new equipment will be installed.

CENTURY ELECTRIC CO., St. Louis, Mo., has opened district sales offices at Union State Bank Building, 19th and Farnam

SHARPENING HELICAL

At the right, the pin reamer being sharpened has, in addition to helical teeth, a straight tooth running the full length of the taper. This is ground without changing the set-up.

The method of sharpening a steep taper reamer is illustrated below.

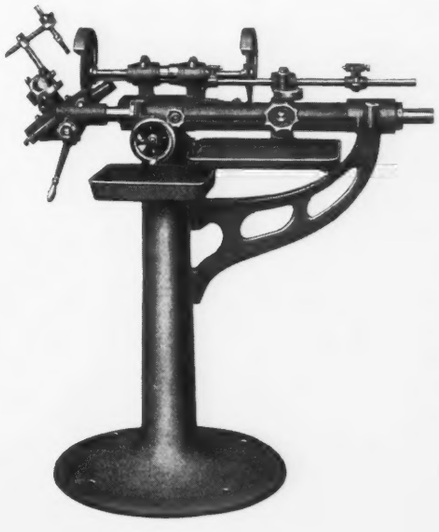


type TAPER REAMERS

—another job for the Brown & Sharpe No. 3 Universal Cutter and Reamer Grinding Machine

USUALLY considered a special equipment job, helical type taper pin and steep taper reamers can be quickly restored to their highest cutting efficiency on the standard Brown & Sharpe No. 3 Universal Cutter and Reamer Grinding Machine. After very little instruction the average operator will regard the sharpening of this type of reamer as a relatively easy job.

In addition to this work, the No. 3 is readily adaptable to the endless variety of cutter and tool grinding jobs that come to the toolroom daily.



BROWN & SHARPE
CUTTER and TOOL GRINDING MACHINES

No. 1	No. 13	Nos. 2 and 3
Tool	Universal and Tool	Cutter and Tool

Install one of these machines to help you get the most out of your production equipment.

Remember these Features—

MODERATE COST
FAST
SMALL FLOOR SPACE
EASY TO OPERATE

An Economical Investment in lowering Tool and Cutter Costs

We shall be glad to send complete specifications at your request.

BROWN & SHARPE

BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

St., Omaha, Neb., and at 718 Continental Bank Building, Monument Place and Meridian St., Indianapolis, Ind.

PORTER-CABLE MACHINE CO., Salina and Wolf Sts., Syracuse, N. Y., has appointed Manning, Maxwell & Moore, 27 N. Jefferson St., Chicago, Ill., exclusive representative of the company for the sale of Porter-Cable production lathes in parts of Illinois, Iowa, and Indiana.

STUEBING COWAN CO., Cincinnati, Ohio, builder of lift and industrial trucks and skids, has recently enlarged its Holyoke plant, the increased demand for its product having made it necessary to triple the present capacity. Considerable new equipment has also been added.

ROCKFORD DIE & TOOL WORKS, Rockford, Ill., has moved from 727 Seventh St. to a new plant which it has recently erected at 1816 Seventeenth Ave. The new plant affords a floor space of over 5000 square feet. It is constructed of concrete and brick throughout, and is entirely fireproof.

PREST-O-LITE CO., INC., 30 E. 42nd St., New York City, has started operations at its thirty-ninth acetylene gas plant, located at 925 Hughes St., Houston, Tex. A. J. Harrower is the superintendent of the new plant, and H. F. Sautter is district superintendent, with headquarters at the Dallas plant.

BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa., has purchased a substantial interest in the business of the Geo. D. Whitcomb Co. at Rochelle, Ill., manufacturer of a complete line of gasoline, distillate, oil, and alcohol-burning locomotives for railway switching, as well as industrial and contracting activities.

ARTHUR JACKSON MACHINE TOOL CO., 9 Front St., East, Toronto 2, Canada, has recently opened a new office at 303 Heintzman Building, Ouellette St., Windsor, Ontario, under the management of Harry Dobson. This company represents a number of United States and British machine tool manufacturers in Canada.

GEO. D. ROPER CORPORATION, Rockford, Ill., has appointed Lewis & Co., of Philadelphia, Pa., representative for the sale of Trahern rotary pumps in the territory comprising the states of Delaware, Maryland, New Jersey, and Virginia, the District of Columbia, and the eastern section of Pennsylvania as far west as Altoona.

ROLLER-SMITH CO., 233 Broadway, New York City, announces that the company is now being represented in Colorado, Utah, Wyoming, and northern New Mexico by Jackson Brown, Jr., 701 Kittridge Bldg., Denver, Colo. The Manila Machinery & Supply Co., Inc., Manila, is representing the company in the Philippine Islands.

BONNEY FORGE & TOOL WORKS, Allentown, Pa., announces that their No. 33 set of double-end box wrenches—nine wrenches with openings from 7/16 to 15/16 inch—are now put up in an attractive metal carrying case. These wrenches combine strength with thinnes and light weight, and are particularly adapted for close corner work.

GEUDER, PAESCHKE & FREY CO., St. Paul Ave. and 15th St., Milwaukee, Wis., has appointed E. H. Wood, 220 Delaware Ave., Buffalo, N. Y., and Charles E. Davis, 888 The Arcade, Cleveland, Ohio, representatives for the stamping, forming, and pressed metal contract department of the company in the Buffalo and Cleveland territories, respectively.

BERGER MFG. CO., Canton, Ohio, subsidiary of the Central Alloy Steel Corporation, has acquired the metal furniture division of the Van Dorn Iron Works Co., Cleveland, Ohio. For the present, the manufacturing and sales of the Van Dorn lines will be continued at Cleveland. The purchase includes all the Van Dorn metal furniture machinery, tools, and inventory in process.

ERIE FOUNDRY CO., Erie, Pa., has recently purchased from the Beaudry Co., Inc., of Boston, Mass., the Beaudry line of motor-driven air hammers, in which the air compressor and motor are an integral part of the hammer. These hammers will be built in all sizes up to 2500 pounds capacity. The company will continue to build its line of steam drop-hammers, board drop-hammers, forging hammers, and trimming presses.

MORRISON MACHINE CO., 204 Van Houten Ave., Paterson, N. J., maker of textile dyeing and finishing machinery and the Morrison line of speed-reducing transmissions, has sold its present plant and acquired the Cook plant of the American Locomotive Co., corner of Getty and Madison Ave., Paterson, N. J. The new plant is a one-story construction and covers a total of 92,000 square feet. There is a separate two-story office building.

SURFACE COMBUSTION CO., Toledo, Ohio, manufacturer of gas burners and gas-fired furnaces, has purchased the WEBSTER ENGINEERING CO., Tulsa, Okla., maker of a low-pressure radiant gas burner for power boilers and heating boilers. The offices and shops of the Webster Engineering Co. will be maintained at Tulsa and will be operated as a division of the Surface Combustion Co. The new officers of the company are Henry O. Loebell, president; Frank H. Adams, vice-president; and L. S. Reagan, general manager.

AVEY DRILLING MACHINE CO., INC., Cincinnati, Ohio, is just completing a four-story and basement addition to its plant. The new building is 90 by 50 feet, of modern brick, steel, and glass construction. It will add 60 per cent to the present capacity of the plant, this addition having been made necessary by the increased demand for the company's line of drilling and tapping equipment, cutting-off machines, and pulley lathes, as well as by the manufacturing requirements for the line of Berjo machine and bench vises now built by the company.

EASTERN MACHINERY CO., Cincinnati, Ohio, formerly located at 408 E. Pearl St., has moved to a new location at 3261 Spring Grove Ave., where the company will occupy a modern building, 500 by 70 feet, in which both the office and the shop will be located. The shop is equipped with modern machinery for the rebuilding of machine tools. It has track facilities on the Baltimore & Ohio Railroad, and is served by two 10-ton cranes, making it possible to handle expeditiously the company's growing business in used and rebuilt machine tools.

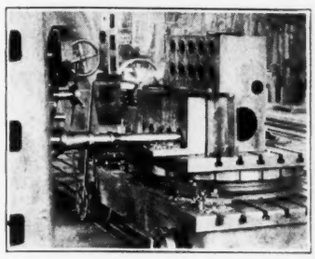
NEW DEPARTURE MFG. CO., Bristol, Conn., maker of New Departure ball bearings, is making plans for extensive additions to its factory. The new buildings will add 250,000 square feet of floor space to the main works at Bristol, and approximately 80,000 square feet to the Meriden plant. The addition to the forge plant at Bristol has just been completed, adding 25,000 square feet to that plant. The new building at Bristol will be 404 feet long by 128 feet wide, and will house the finish race grinding department. The extension at the Meriden plant will be 220 by 106 feet in size, four stories high.

AMERICAN SWISS FILE & TOOL CO., 410-416 Trumbull St., Elizabeth, N. J., has appointed the Tucker Co., Inc., 75 Murray St., New York City, distributor for the company's line of mechanics' hand tools and knurls. The territory of the Tucker Co., will include New York, New Jersey, New England, Pennsylvania, Delaware, Maryland, and the District of Columbia. The appointing of the Tucker Co. as tool distributor in the territory mentioned in no way affects any distributors of the present American Swiss precision files, which are handled as an entirely separate line, both as regards the manufacture and distribution.

COLT'S PATENT FIRE ARMS MFG. CO., Hartford, Conn., maker of the Colt Autosan washing and cleaning machines, announces the appointment of Thomas M. Small to take charge of sales and service in the New York territory including New Jersey, Philadelphia, and Washington, with offices at 20 Vesey St., New York City. He will be assisted in this district by Russell Chico. H. A. Seiferman has been placed in charge of sales and service in the Cleveland district, including Buffalo and Rochester, N. Y. This territory was formerly covered from the Chicago office. The Colt Autosan conveyor and revolving models of metal cleaning machines will also come under the supervision of these offices in their respective territories.

KRUPP NIROSTA CO., INC., announces through its president, H. G. Batcheller, the purchase by that corporation of the three Johnson patents covering the analysis and manufacture of Rezistal corrosion and heat-resisting steel from the Crucible Steel Co. of America, the latter having acquired an interest in the Krupp Nirosta Co., Inc. Previously, the Krupp Nirosta Co. had acquired some of the Ludlum patents and the Krupp heat-treating patents which cover Nirosta steels. The Crucible Steel Co. of America is now licensed to manufacture under all patents controlled by the Krupp Nirosta Co. In addition to the Crucible Steel Co. of America, other licensees include the Central Alloy Steel Corporation; the Ludlum Steel Co.; the Babcock and Wilcox Tube Co.; the Firth-Sterling Steel Co.; Spang, Chalfant & Co.; the Lukens Steel Co.; and the Wallingford Steel Co.

Typical Performance

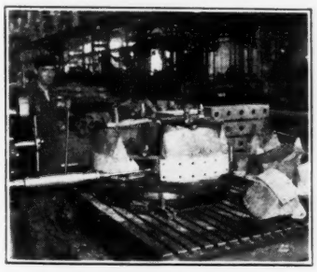


Total time including setting 150 hours, 42 min.

Pump Body for 24,000 Bbl. Oil Pipe Line Pump Machine clamped on 4 ft. Turn Table. Material: Open Hearth Steel 1.30% Carbon. Size: 23" x 29½" x 36½". Weight: 5700 lbs.

Drill & Tap		10	Holes	1 ¼"	dia.	x 1½"	deep
"	"	12	"	1⅛"	"	x 1⅜"	"
"	"	80	"	1"	"	x 1¼"	"
"	"	38	"	⅞"	"	x 1⅛"	"
"	"	18	"	¾"	"	x 1"	"
"	Bore	1	"	3½"	"	x 36½"	"
"	"	5	"	3½"	"	x 26"	"
"	"	5	"	3½"	"	x 10"	"
"	"	20	"	1"	"	x 7½"	"
"	"	10	"	2⅜"	"	x 2"	"
"	"	10	"	2¼"	"	x 4" (See note A)	"
"	"	20	"	3⅛"	"	x 2½"	"
"	"	1	"	8½"	"	x 33¼"	"

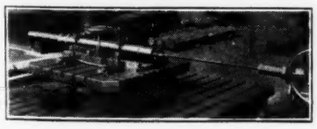
Note "A"—These holes were drilled at different angles to the horizontal and vertical planes which required six different angular settings of the table.



20 BUCKETS DRILLED IN 14¼ HOURS
Floor to Floor Time

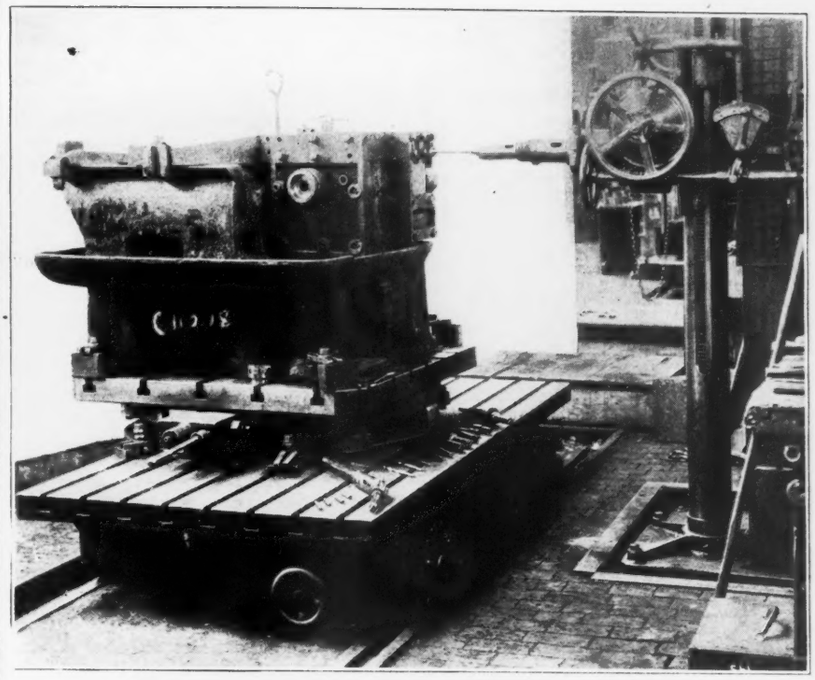
Every Pair of Holes at a Different Angle

Four ditcher buckets, each weighing 85 lbs., mounted on a 4' turntable. Twelve 13/16" holes drilled through 1⅛" material. Two 1" holes drilled through ¾" material. Drilled from 8 positions with one clamping.



DRILLING JACK SHAFT

A number 1 Ryerson Horizontal drilling a 1" hole 36" deep and a 1" hole 15" deep in Hyten steel 45 carbon. Jack shaft weighing 225 lbs., mounted on turntable with special automatic jig for quick movement of shaft.



Big Saving in Total Time

Drill Four and Five Sides of a Job From the One Set-up

CUT your floor-to-floor time. Drill the entire job—four sides—from the one setting, on a simple rotary table.—Or drill five sides with a universal tilting and revolving table. One set-up will handle it all.

The set-up job is easier too. The worktable is at the side of the drill with no overhanging parts to interfere. The Horizontal Method of drilling permits setting the piece upright, making the job much simpler.

Drilling, too, is faster and cleaner. Drilling pressure is against a heavy vertical column. The chips fall away from the hole, keeping the drill clean.

The Ryerson Horizontal is saving time on all types of work. It can do the same for you.

Write for Complete Information, Specifications, and Prices. Ask for Bulletin A-4051.

JOSEPH T. RYERSON & SON INC.

ESTABLISHED 1842

Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Pittsburgh, Philadelphia, Boston, Jersey City, New York, Richmond, Houston, Tulsa, Los Angeles, San Francisco, Denver, Minneapolis, Duluth

Drill it Horizontally

COMING EVENTS

APRIL 8-12—American Foundrymen's Association convention at Hotel Stevens, Chicago, Ill. Headquarters of association, 140 S. Dearborn St., Chicago, Ill.

APRIL 9-11—Sixth annual convention of the American Oil Burner Association to be held at the Hotel Pennsylvania, New York City. Further information may be obtained from the Oil Heating Institute, 342 Madison Ave., New York.

APRIL 17-19—Sixteenth National Foreign Trade Convention at the Lord Baltimore Hotel, Baltimore, Md. O. K. Davis, secretary, National Foreign Trade Council, India House, 1 Hanover Square, New York City.

APRIL 24-25—Convention of the National Metal Trades Association to be held at the Drake Hotel, Chicago, Ill. J. E. Nyhan, national secretary, Peoples Gas Building, Chicago. Ill.

APRIL 24-26—Annual meeting of the American Welding Society at the Engineering Societies Building, 29 W. 39th St., New York City. M. M. Kelly, secretary, 29 W. 39th St., New York City.

MAY 6-8—Annual spring convention of the American Management Association at the Hotel Pennsylvania, New York City. For further information, address the American Management Association, 20 Vesey St., New York City.

MAY 6-11—Twelfth exposition of the Chemical Industries at the Grand Central Palace, New York City. For further information address Chemical Industries Exposition Office, Grand Central Palace, New York City.

MAY 13-15—Meeting of the American Society of Mechanical Engineers at Rochester, N. Y. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

MAY 16-18—Annual meeting of the American Gear Manufacturers' Association to be held at the Hotel Statler, Cleveland, Ohio. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland, Ohio.

JUNE 19-21—International Management Congress to be held at Paris, France. A large delegation from America will attend. For further information, address the American Management Association, 20 Vesey St., New York City.

JUNE 24-28—Annual meeting of the American Society for Testing Materials at the Chalfonte-Haddon Hall Hotel, Atlantic City, N. J. C. L. Warwick, Secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

JULY 1-4—Summer meeting of the American Society of Mechanical Engineers at Salt Lake City, Utah. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

SEPTEMBER 9-13—Annual convention of the American Society for Steel Treating at Cleveland, Ohio. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

SEPTEMBER 9-13 — Eleventh National Metal Exposition under the auspices of the American Society for Steel Treating at the Cleveland Public Auditorium, Cleveland, Ohio. For further information address W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland.

SEPTEMBER 30 - OCTOBER 4 — Machine Tool Exposition held by the National Machine Tool Builders' Association in the Public Auditorium, Cleveland, Ohio. Ernest F. DuBrul, general manager, Provident Bank Building, Cincinnati, Ohio.

NEW BOOKS AND PAMPHLETS

STANDARDS YEARBOOK (1929). 401 pages, 6 by 9 inches. Published by the Department of Commerce, Washington, D. C., as Miscellaneous Publication No. 91 of the Bureau of Standards. Price, $1.

REVIEW OF IRON AND STEEL LITERATURE FOR 1928. By E. H. McClelland, Technology Librarian, Carnegie Library of Pittsburgh, Pittsburgh, Pa. 23 pages, 5 by 7 inches. Distributed by the Carnegie Library, Pittsburgh, Pa.

SAFETY IN WELDING. 16 pages, 5 1/4 by 7 1/2 inches. Distributed by the Policyholders' Service Bureau of the Metropolitan Life Insurance Co., 1 Madison Ave., New York City, without charge.

This little pamphlet is based on a study of welding practices, and presents the outstanding health and accident hazards involved, with suggestions for overcoming them.

ANALYTIC MECHANICS. By Joseph B. Reynolds. 347 pages, 6 by 9 inches. Published by Prentice-Hall, Inc., 70 Fifth Ave., New York City. Price, $4.

This text in analytic mechanics is intended primarily for students in technical schools and colleges. With some omissions, it is believed that the text can be used equally well as the basis of a course in pure or theoretical mechanics. About 700 carefully graded exercises are given for the student to solve, and about one-fourth as many illustrative examples are solved and explained in order to demonstrate the method of applying the principles. The material is divided into fourteen chapters dealing with the following subects: Definition and subject matter of mechanics, fundamental units, and systems of units; kinematics; motion; velocity; acceleration; and harmonic motion; kinetics; parallel motion; constrained motion; projectiles; friction; miscellaneous applications; center of gravity and moment of inertia; plane motion; impact; work and energy.

AIRPLANE STRESS ANALYSIS. By Alexander Klemin. 277 pages, 6 by 8 1/2 inches. Published by the Ronald Press Co., 15 E. 26th St., New York City. Price, $7.

This book has been prepared as an introductory treatise on the art of airplane stress analysis. It is especially designed to meet the needs of college students in aeronautics, engineers, and designers, who require an accurate and complete, though simple, treatment of the subject. It is also designed to cover adequately the stress requirements of the Department of Commerce, particularly as regards the small commercial airplane. The subject is handled with clearness and simplicity. The rules of the Department of Commerce have been presented in a form that can be readily understood by a reader to whom the subject is new. A preliminary review of the principles of applied mechanics has been included, as this is the basis for all structural analysis. The application of the formulas developed to the calculation of airplane stresses is shown by using a hypothetical airplane as an illustration. All calculations are carried through in logical sequence in much the same way as when an actual analysis is made for submission to the Department of Commerce. A feature that increases the usefulness of the book is the assembly in convenient, concise form of all information regarding the materials employed in aircraft construction.

NEW CATALOGUES AND CIRCULARS

FLEXIBLE COUPLINGS. T. B. Wood's Sons Co., Chambersburg, Pa. Bulletin 172, containing data on universal Giant flexible couplings.

CONTROL VALVES. Bristol Co., Waterbury, Conn. Catalogue 2000, containing data on automatic electric control valves of the motor-operated and magnet types.

TUBE COUPLINGS. Parker Appliance Co., 10320 Berea Road, Cleveland, Ohio. Bulletin containing data on Parker tube couplings for joining pipes and tubes in power plants.

BALL BEARINGS. New Departure Mfg. Co., Bristol, Conn. Sheet 189 FE for loose-leaf binder, descriptive of a vertical woodworking spindle equipped with grease-lubricated ball bearings.

BENCH LATHES. Rivett Lathe & Grinder Corporation, Brighton, Boston, Mass. Bulletin 505-B, illustrating and describing the Rivett Manufacturers Production bench lathe and equipment.

BELTS. L. H. Gilmer Co., Cottman and Keystone Sts., Tacony, Philadelphia, Pa. Leaflet containing price list of Gilmer V-belts and tables of power ratings, minimum pulley sizes, and pulley grooves.

STEAM DROP-HAMMERS. Erie Foundry Co., Erie, Pa. Bulletin 190, illustrating and describing the features of Erie steam drop-hammers, which are built in sizes rated at from 400 to 20,000 pounds.

WELDING EQUIPMENT. Linde Air Products Co., 30 East 42nd St., New York City. Booklet containing a reprint of an article entitled "Oxwelding Pressure Vessels," published in *Oxy-acetylene Tips*.

ELECTRIC EQUIPMENT. Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo. Bulletin 161, containing instructions for the installation and operation of power and distribution transformers.

PUNCHES AND DIES. Whitney Metal Tool Co., 112 Forbes St., Rockford, Ill. Circular entitled "There is a Big Difference Where You Buy Punches and Dies," showing some examples of Whitney punches and dies.

REDUCTION GEARS. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Publication DMF-5128, entitled "A Triumph of Mechanical Engineering," outlining the history of reduction gears for marine engines.

PULLEYS. American Pulley Co., 4200 Wissahickon Ave., Philadelphia, Pa. General catalogue, covering the complete line of American steel split pulleys and other pressed-steel products, including hangers, bearings, trucks, etc.

HARDENING EQUIPMENT. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Pamphlet No. 15 in a series on heat-treating, describing how the Bassick Co. hardens slender mandrels by the aid of a Hump method furnace.

KNIFE GRINDERS. Samuel C. Rogers & Co., 199 Dutton Ave., Buffalo, N. Y. Sixteen-page illustrated price list for 1929. This list includes two new products of the company, the new Rogers knife grinder and a segmental wheel chuck.

THREADING DIES. Jones & Lamson Machine Co., Springfield, Vt. Circular made in the form of a threading die advertising Hartness automatic dies equipped with J & L chasers, which are ground and lapped in the thread after hardening to insure accuracy.

OIL-CUPS AND LUBRICATING DEVICES. Gits Bros. Mfg. Co., Chicago, Ill. General catalogue 23, containing complete data for the Gits line of lubricating devices, including oil- and grease-cups, high-pressure grease guns and fittings, oil gages, multiple-feed oilers, etc.

WELDING EQUIPMENT. Lincoln Electric Co., Cleveland, Ohio. Pamphlet containing a reprint of a paper by J. F. Lincoln, entitled "Suggested Designs for Arc-welded Connections in Building Construction," presented at the Fall meeting of the American Welding Society.

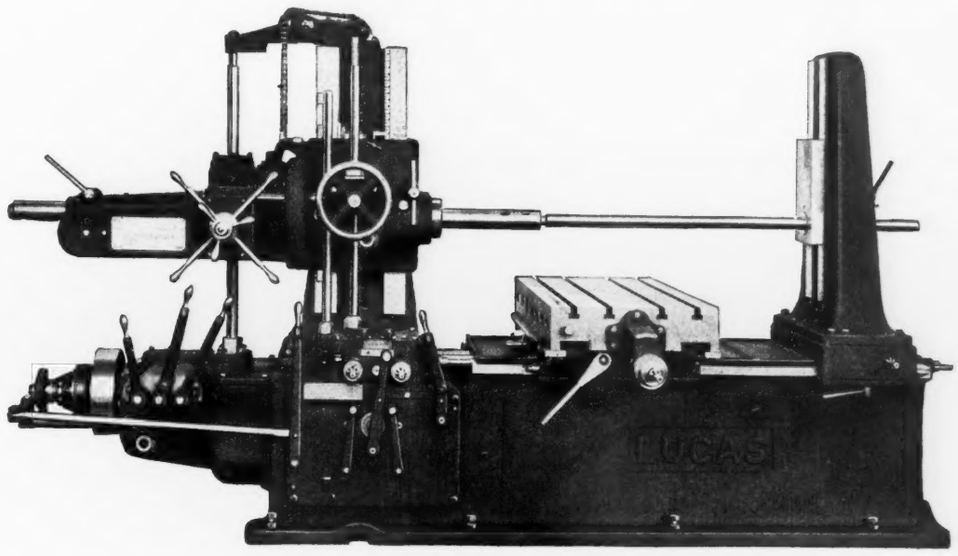
ZINC METAL AND ALLOYS. New Jersey Zinc Co., 160 Front St., New York City. Booklet containing data on zinc, metal and alloys, including information on the constituents of different alloys, methods of analysis, physical and mechanical properties, and summary of uses.

POLISHING AND BUFFING. Divine Brothers Co., Utica, N. Y. Pamphlet entitled "Pointers on Buffs for the Purchasing Agent," by B. H. Divine, president of the company. This pamphlet contains a great deal of specific information relating to buffs, their construction and use.

CRANES AND HOISTS. Shepard - Niles Crane & Hoist Corporation, Montour Falls, N. Y. Circular announcing a complete line of cranes and hoists, ranging from 1/2 ton to 450 tons capacity. This circular shows a number of applications of traveling cranes and electric hoists.

MATERIAL HANDLING EQUIPMENT. Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. Bulletin illustrating the application of the Cleveland overhead tramrail system to the handling of materials from the raw stock to the finished product.

Quality Must Be Paramount —
We Do No Trading on Past Reputation



The Quality of the

"PRECISION"

Boring, Drilling and MILLING MACHINE

is not only kept up, but improved whenever possible.

WE ALSO MAKE THE
LUCAS POWER
Forcing Press

The new model 3" spindle No. 41 Machine is illustrated and described with detailed specifications in circular A-40.

Circular B-2 pertains to the larger size No. 42 and No. 43 Machines with 4" and 5" spindles.

May we tell you about the many advantageous features of these improved machines?

THE LUCAS MACHINE TOOL CO., Cleveland, Ohio, U.S.A.

FOREIGN AGENTS: Allied Machinery Co., Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo. Ing. M. Kocian & G. Nedela, Prague. Emanuele Mascherpa, Milan, Italy.

NICKEL ALLOY STEELS. International Nickel Co., Inc., 67 Wall St., New York City. Buyers' Guide of Nickel Alloy Steel Products for January 1, 1929, containing a classified list of alloy steel products, together with the names and addresses of manufacturers arranged in alphabetical order.

ELECTRIC FURNACES. H. O. Swoboda, Inc., 3400 Forbes St., Oakland Station, Pittsburgh, Pa. Bulletin 140, descriptive of the Falcon continuous electric furnace for heat-treating strip metal and wire. The circular is illustrated with halftones and line drawings illustrating the construction.

POWER PLANT INSTRUMENTS. Brown Instrument Co., 4485 Wayne Ave., Philadelphia, Pa. Forty-eight-page book entitled "Power Plant Instrument Data Book," describing 105 applications of instruments for measuring temperatures, pressures, flows, liquid levels, and machine speeds in the steam power plant.

SELF-LOCKING BOLTS AND NUTS. Dardelet Threadlock Corporation, 120 Broadway, New York City. Catalogue entitled "The Challenge to Vibration," descriptive of the Dardelet "Threadlock," a self-locking bolt and nut. The bulletin explains the principle of action, advantages, and field of application.

CLUTCHES. Carlyle Johnson Machine Co., Manchester, Conn. Loose-leaf clutch catalogue showing the various sizes and types of Johnson friction clutches, and giving prices, dimensions, etc. The application of these clutches in about a dozen different large industrial fields is illustrated, a separate catalogue being arranged for each industry.

DIE SETS. E. A. Baumbach Mfg. Co., 1810 S. Kilbourn Ave., Chicago, Ill. Catalogue 5, entitled "The Baumbach Die Set Guide," containing complete information on the Baumbach line of automatically oiled die sets and accessories. The various styles of die sets are illustrated, and tables containing prices and dimensions are included.

STEEL CASTINGS. Sivyer Steel Casting Co., Milwaukee, Wis. Booklet entitled "Dependability in Steel Castings," issued in celebration of the twentieth anniversary of the pouring of the first heat at this company's plant. The booklet describes the various steps in the process of making a steel casting and the methods employed to maintain dependability.

PNEUMATIC TOOLS. Rotor Air Tool Co., Cleveland, Ohio. Catalogue 6, of Rotor portable pneumatic tools, including grinders, buffers, sanders, and drills. The bulletin points out how production savings can be made by the use of these tools, and describes the features of construction. Different applications of the various tools are shown, and specifications are given.

REGROUND BALL BEARINGS. Ahlberg Bearing Co., 317-327 East 29th St., Chicago, Ill. Booklet entitled "The Story of Ahlberg Ground Bearings," covering in detail the development of the production processes which have made it possible to reclaim worn ball bearings. The booklet tells of the system of exchange which the Ahlberg Ground Bearing Service has built up.

FUSE PULLERS. Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill. Trade price list, describing "Ideal" fuse pullers, which are made of laminated fiber, and are designed to eliminate the danger of pulling and replacing cartridge fuses by hand. Four sizes are manufactured, ranging in length from 5 to 20 inches, and in number of laminations, from three to nine.

GEARS. Ohio Gear Co., 1333 E. 179th St., Cleveland, Ohio. Catalogue 29, listing Ohio stock gears. The data covers dimensions, material, list prices, etc. Among other matter included are spur and bevel gear formulas, tables of diametral and circular pitch, strength of gear teeth, weights of steel rounds per inch of length, and S.A.E. steel specifications and heat-treatments.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletins GEA-432A, 1075 and 1088, illustrating and describing, respectively, direct-current generators and exciters; temperature-indicating equipments for alternating-current generators and motors; and battery-charging equipment. Bulletin GEA-902, descriptive of the electrification of the New York Central Railroad.

ELECTRIC EQUIPMENT. Electric Controller & Mfg. Co., Cleveland, Ohio. Bulletins 960, 1004-A, 1035, and 1100, dealing, respectively, with type V Dinkey controllers for direct-current motors; type WB brakes; safety limit stops for alternating- and direct-current motors; and automatic altitude and pressure regulators and cushion tanks. Price sheets are being distributed with these bulletins.

CRANES AND HOISTS. Canton Foundry & Machine Co., Canton, Ohio. Catalogue descriptive of the Canton line of portable floor cranes and hoists, which are now being furnished with safety friction load brakes, by means of which the load is automatically held at any point without effort on the part of the operator. The various styles of hoists are illustrated, and concise data given with reference to each.

MILLING MACHINES. Sundstrand Machine Tool Co., Rockford, Ill. Bulletin entitled "Rigidmiling Principles and Practice," descriptive of the horizontal, vertical, reciprocating and rotary milling machines known as "Rigidmils." The various types are illustrated, some of their advantages are set forth and typical applications are shown. Copies of this bulletin will be sent to those interested upon request.

INTERCHANGEABLE COUNTERBORES. Eclipse Interchangeable Counterbore Co., Detroit, Mich. Circular illustrating and describing the Eclipse improved quick-adjustable-length holder, which can be instantly adjusted by hand without wrenches or other tools. These holders are particularly adapted for multiple-spindle spot-facing, counterboring, countersinking, or core-drilling to specified depth, or with cutters of varying length.

POLISHING AND BUFFING MACHINES. Divine Brothers Co., Utica, N. Y. Catalogue of machines for flexible grinding, polishing and buffing, containing descriptions and specifications of automatic flat stock polishing and buffing machines, sheet polishing machines, rod polishing machines, double-header polishing machines, glazing machines, automatic grinding and polishing machines, and buffing machines of different types, together with auxiliary equipment required in buffing and polishing machine installations.

REBUILT MACHINERY. J. L. Lucas & Son, Inc., 3 Fox St., Bridgeport, Conn. Bulletin 75, containing a list of rebuilt machinery immediately available, including machinery for general manufacturing; tool-room tools; screw machinery; stamping machinery; forging machinery; nut, bolt, and rivet machinery; rolling mill and sheet metal machinery; wire and special machinery; general factory equipment; and miscellaneous equipment. Concise descriptions, together with prices of each of the machines, are included.

ROTARY PUMPS. Geo. D. Roper Corporation, Rockford, Ill. Catalogue 54, covering the complete line of Trahern rotary pumps of both the hand and power type for coolant and lubricating purposes, and various other purposes in factories and machine shops. Views showing typical installations indicate the wide field of use for pumps of this kind. Capacity and horsepower performance curves for the various types are included. The catalogue is of the loose-leaf form, so that pages covering new developments can be added from time to time.

WELDING EQUIPMENT. Wilson Welder & Metals Co., Inc., Wilson Bldg., Hoboken, N. J., is distributing a series of bulletins on the subject of economy in arc-welding practice. Bulletins A, B, C, D, and E treat, respectively, of the following subjects: Welding Cables, A Brief History of Electric Arc-welding; Process of Welding Copper, Brass, Monel, Bronze, Nickel, Aluminum, and Machinable Cast Iron Welds; Economy Effected by Arc-welding Practice in the New York Edison East River Station; Good Welding Essentials. Bulletins 1-D and 4-C illustrate and describe Wilson motor-driven welding machines, and bulletin 100-D gives data on arc-welding wire.

OBITUARIES

A. LEWIS JENKINS

A. Lewis Jenkins, head of the Mechanical Engineering Department of the College of Engineering and Commerce, University of Cincinnati, died March 8, after a long illness, at the age of forty-eight years. He was born near Springfield, Ky., and was a graduate of the University of Kentucky and of the University of Cincinnati. After his graduation, he was first employed as an engineer with the municipal pumping and power station at Jackson, Tenn., and for the last twenty-four years has been connected with the University of Cincinnati, where he has devoted much of his time and ability to the development of courses of instruction in mechanical engineering that would be suitable in connection with the co-operative plan of engineering education inaugurated over twenty years ago by Dr. Herman Schneider, formerly Dean of the College of Engineering of the university.

Some years ago, Professor Jenkins contributed to MACHINERY a series of articles on the design of punches, shears, and presses. This series is one of the most complete and logical presentations of this subject that has ever been undertaken, and these articles, as well as his papers contributed to engineering societies on the analysis of combined stresses and their application to practical designs in machine construction, constitute an original contribution to engineering literature of great value.

Professor Jenkins is well known for his qualifications as an engineering teacher not only in America but also in Europe, and during 1924-1925, he was exchange professor at Roberts College in Constantinople.

ALEXANDER ADAMSON, founder and president of the Adamson Machine Co., Akron, Ohio, died March 3.

According to the Department of Commerce, the miles of airways operated in the United States at the end of January this year were close to 20,000. Mail was carried over airways covering about 17,500 miles. It is estimated that there are about 8800 airplanes in this country, in addition to those used by the Government. Of this total, 5653 were registered on January 1 this year. California leads in the number of registered planes, having over 800.